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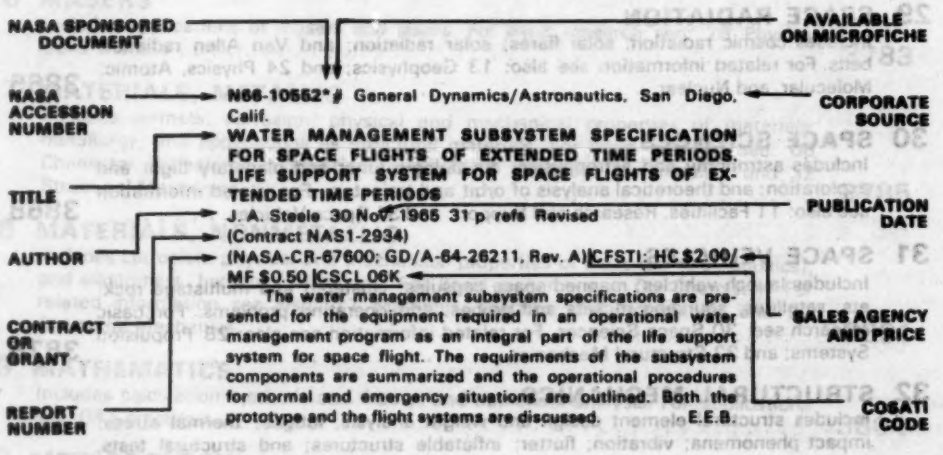
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N66-10552*# General Dynamics/Astronautics, San Diego, Calif.
CORPORATE SOURCE
WATER MANAGEMENT SUBSYSTEM SPECIFICATION FOR SPACE FLIGHTS OF EXTENDED TIME PERIODS. LIFE SUPPORT SYSTEM FOR SPACE FLIGHTS OF EXTENDED TIME PERIODS
TITLE
PUBLICATION DATE
J. A. Steele 30 Nov. 1965 31 p refs Revised
AUTHOR
(Contract NAS1-2934)
(NASA-CR-67600; GD/A-64-26211, Rev. A) CFSTI: HC $2.00/MF $0.50 CSCL 06K
CONTRACT OR GRANT
SALES AGENCY AND PRICE
The water management subsystem specifications are presented for the equipment required in an operational water management program as an integral part of the life support system for space flight. The requirements of the subsystem components are summarized and the operational procedures for normal and emergency situations are outlined. Both the prototype and the flight systems are discussed. E.E.B.
REPORT NUMBER
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VOLUME 4 NUMBER 19

Scientific and Technical Aerospace Reports

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October 8, 1966

01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N66-33015*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

ROUGHNESS EFFECTS ON BOUNDARY-LAYER TRANSITION FOR BLUNT-LEADING-EDGE PLATES AT MACH 8

Paul F. Holloway and E. Leon Morrisette Washington, NASA, Aug. 1966 42 p refs

(NASA-TN-D-3517) CFSTI: HC $2.00/MF $0.50 CSCL 01A

An investigation has been conducted to determine the effects of controlled roughness (spheres) on boundary-layer transition for unswept, blunted plates at a free-stream Mach number of 8. The location of boundary-layer transition was determined by heating-rate distribution downstream of the roughness element on the center line of the plates. Experimental data are presented for leading-edge bluntnesses of 0.125 and 0.375 inch (0.318 and 0.953 cm). Tests were made for an angle of attack of 0° and for a test unit Reynolds number per foot (per 30.5 cm) between 1.2×10^6 and 9.2×10^6. Correlation of data for both sharp- and blunt-leading-edge plates by the method of Potter and Whitfield was successful. An evaluation of the application of this correlation technique has been discussed. Author

N66-33017*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

HYPERSONIC LAMINAR VISCOUS INTERACTION EFFECTS ON THE AERODYNAMICS OF TWO-DIMENSIONAL WEDGE AND TRIANGULAR PLANFORM WINGS

Mitchell H. Bertram Washington, NASA, Aug. 1966 86 p refs

(NASA-TN-D-3523) CFSTI: HC $3.00/MF $0.75 CSCL 01A

Solutions have been obtained of the effect of viscous interaction not only on the pressure and skin friction but also on the aerodynamic forces of a sharp-leading-edge flat surface. The analysis assumes the applicability of laminar-hypersonic-local-similarity-boundary-layer theory in a perfect gas with Prandtl number unity and a constant ratio of specific heats. The results are presented in the form of correlation graphs which cover a large range of plate incidence and viscous interaction parameter and allow the effects of viscous interaction to be readily determined. Computations are shown for ratios of specific heats of 7/5 and 5/3 and, for the aerodynamic forces, both the two-dimensional wing and the triangular planform wing are considered. The results indicate that the effect of viscous interaction can reduce the lift-drag ratio significantly. Author

N66-33018*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

STAGNATION AND STATIC PRESSURES ON A NOSE MOUNTED 15° CONICAL PROBE WITH VARIOUS FOREBODY CONFIGURATIONS

Edward M. Coates, Jr. Washington, NASA, Aug. 1966 118 p refs

(NASA-TN-D-3528) CFSTI: HC $4.00/MF $1.00 CSCL 01A

An investigation to obtain pressure-distribution data in the subsonic and transonic speed ranges for calibrating a hypersonic conical pressure probe intended for the X-15 research aircraft has been conducted in a 16-foot transonic tunnel. The test vehicle consisted of a 1/3-scale model of the X-15 forebody and the data probe, which was a 15° cone with a hemispherical tip. The probe was investigated with three different lengths or portions of the X-15 forebody to determine the interference of the model body on probe pressure distributions. At subsonic speeds the presence of the body had a noticeable effect on surface static pressures measured by the probe. At speeds above Mach 1 the presence of the model body had no effect on probe pressure distributions. The angle of attack could be measured to an accuracy of about ±0.5° in the Mach number range from 0.30 to 1.29 by using the difference in pressure between an orifice located on the top of the probe and an orifice located on the bottom of the probe. The data indicated that for those orifices which were least sensitive to changes in angle of attack, the difference in the variation of the pressure coefficient with Mach number for angles of attack from 0.2° to 15° was less than 0.1 for Mach numbers up to 1.00. Author

N66-33086 Aix-Marseilles Univ. (France). Fluid Mechanics Inst. of Marseilles.

THEORETICAL AND EXPERIMENTAL STUDY OF THE VISCOUS AND NON-VISCOUS EFFECTS DUE TO THE BLUNTNESS OF THE SLENDER OBSTACLE'S POINT [ETUDE THEORIQUE ET EXPERIMENTALE DES EFFETS VISQUEUX ET NON VISQUEUX DUS A L'EMOUSSEMENT DE LA POINTE DES OBSTACLES ELANCES]

J. Valensi, R. Brun, and J. P. Guiberga [1966] 60 p refs In FRENCH

CFSTI: HC $3.00/MF $0.75

The distribution of the pressure and of the heat flux density at the wall of pointed and blunt-end cones at zero incidence in a hypersonic flow simulating actual flight conditions was determined. Test conditions, measuring devices, shock tunnel

characteristics, and research models are described. Experimental tests on the pointed cones showing the effects of viscous interaction are reported. Expressed in the form of correlation parameters, the test results for blunt-end cones are expressed by a universal curve, no matter what the angle of the cone and the degree of bluntness might be. Data are included on nonviscous flow, boundary layer, imperfect gas, and conicity of the flow. Experimental results demonstrate the basic characteristics of hypersonic flows around cones, and the nonviscous effects due to blunting, as well as the effects of viscous interaction. Transl. by R.Ll.

N66-33141# Aix-Marseilles Univ. (France).
THE REFLECTING SHOCK TUNNEL OF I.M.F.M. (CHARACTERISTICS, MEASURING DEVICES, FINDINGS) [LA SOUFFLERIE A CHOC REFLECHI DE L'I.M.F.M. (CHARACTERISTIQUES, MOYENS DE MESURE, RECHERCHES RECENTES)]
J. Valensi Jun. 1966 19 p refs In FRENCH Presented at a Meeting on Hypersonic Aerodynamics and Tech. for the Study of Rapid Phenomena
(Contracts DRME-63; DRME-64; DRME-65) CFSTI: HC $1.00/MF $0.50

The viscous and nonviscous effects due to blunting the point of half-angle cones were evaluated in shock tunnel tests. Scientific equipment and measuring methods are described. Experimental results obtained for the heat flux at the surface of blunted cones are compared with preliminary calculations, and heat flux and pressure distribution are graphed for both uniform and spherical flow. A formula was evolved and this calculation, taking into consideration the divergence of free flow, enabled preliminary results to be found for measuring the pressure, and the flow. Transl. by R.Ll.

N66-33269# Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Aeronautical Engineering and Astronautics.
[SEPARATION OF AN ORIGINALLY HOMOGENEOUS STREAM INTO TWO OR MORE STREAMS AT DIFFERENT TEMPERATURES] Final Report
Apr. 1966 10 p refs
(Contract DA-31-124-ARO(D)-318)
(TR-AE-6601; AROD-5641-2; AD-633494) CFSTI: HC $1.00/MF $0.50

The nondissipative separation of energy by cryptosteady processes, first analyzed by Foa, and re-examined by Hashem in a comparative study of various methods of energy separation, is discussed. A further extension of the theory of cryptosteady flow energy separation was developed by E.P. Molnar and is summarized in the appendix. A model was assembled for the experimental verification of the theory but would not operate at design speed because of bearing and leakage difficulties. However, the results indicate that resolution of these minor difficulties should lead to an attractive level of performance in agreement with theoretical predictions. R.N.A.

N66-33291# David Taylor Model Basin, Washington, D. C.
TESTS OF THE EFFECTS OF EXIT LENGTH AND CAMBER ON THE STATIC EFFICIENCY OF SHROUDED PROPELLERS Final Report
Arthur E. Johnson Mar. 1966 17 p refs *Its* AERO Rept.-1105
(DTMB-2174, AD-633894) CFSTI: HC $1.00/MF $0.50

The static efficiency of a group of shrouded propellers with exits of various lengths and cambers has been measured experimentally and compared with potential theory calculations. Ratios of shroud chord to exit diameter ranged from 0.40 to 0.55. Straight exit sections and diffusing sections with radii of curvature of 77 and 40 percent of the propeller diameter were tested. The diffusing shrouds with the gentler curvature were found to be the most efficient. Author (TAB)

N66-33306*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
WIND-TUNNEL INVESTIGATION AT A MACH NUMBER OF 2.91 OF STABILITY AND CONTROL CHARACTERISTICS OF THREE LIFTING REENTRY CONFIGURATIONS AT ANGLES OF ATTACK UP TO 90°
John E. Grimaud Washington, NASA, Mar. 1961 42 p refs (NASA-TM-X-455) CFSTI: HC $2.00/MF $0.50 CSCL 01A (Declassified)

The configurations were of the type that would reenter the earth's atmosphere near maximum lift. Longitudinal control for the models was provided by flaps which extended beyond the trailing edge of each wing. Directional stability was provided by fins located at the tip of each wing. One model was tested over an angle-of-attack range from −4° to 90° with flap deflections ranging from 0° to ±70°. This model was also tested over a combined angle-of-attack and angle-of-sideslip range with angles of attack up to 51°. Tests on the other two models were restricted to an angle-of-attack range near maximum lift for flap deflections ranging from 0° to −50°. Results indicated that one model could be trimmed and was longitudinally stable over an angle-of-attack range up to 41° with the center of gravity located at 58 percent of the body length. This model was also directionally stable over a combined angle-of-attack and angle-of-sideslip range with angles of attack up to 50°. Author

N66-33311*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AERODYNAMIC PERFORMANCE AND STATIC STABILITY AND CONTROL OF FLAT-TOP HYPERSONIC GLIDERS AT MACH NUMBERS FROM 0.6 TO 18
Clarence A. Syvertson, Hermilo R. Gloria, and Michael F. Sarabia Washington, NACA, 17 Sep. 1958 65 p refs
(NACA-RM-A58617) CFSTI: HC $3.00/MF $0.75 CSCL 01D (Declassified)

An experimenta study was made of the aerodynamic performance and static stability and control of hypersonic gliders with arrow plan-form wings. By the use of conventional test techniques, application of the hypersonic similarity rule, and/or the use of helium as a test medium, performance results were obtained for Mach numbers from 3 to 18 and stability and control results for Mach numbers from 0.6 to 12. Author

N66-33312*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ADDITIONAL EXPERIMENTS WITH FLAT-TOP WING-BODY COMBINATIONS AT HIGH SUPERSONIC SPEEDS
Clarence A. Syvertson, Thomas J. Wong, and Hermilo R. Gloria Washington, NACA, 19 Feb. 1957 52 p refs
(NACA-RM-A56111) CFSTI: HC $3.00/MF $0.50 CSCL 01A (Declassified)

An experimental study is made of the effects of several variations in configuration geometry on the aerodynamic characteristics of flat top wing body combinations. In general, these configurations consist of one half of a body of revolution mounted beneath a wing of essentially arrow plan form. At the root, the wing leading edge coincides with the nose of the fuselage and the trailing edge coincides with the fuselage base. Variations in model geometry studied include wing trailing edge sweep, the addition of auxiliary bodies, downward deflection of wing tips to simulate vertical fins, wing dihedral, wing

leading edge sweep, fuselage fineness ratio, and fuselage profile shape. Lift, drag, and pitching moment characteristics were obtained at Mach numbers from 3.00 to 6.28 and angles of attack up to 4°. At Mach numbers from 3 to 5, 60 percent of the maximum lift–drag ratios measured were greater than 6. The highest maximum lift–drag ratios measured were 7.2 at M=3.00 and M.4.24, 6.6 at M=5.05, and 5.3 at M=6.28.

Author

N66-33313*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

DYNAMIC STABILITY INVESTIGATION OF TWO RIGHT CIRCULAR CYLINDERS IN AXIAL FREE FLIGHT AT MACH NUMBERS FROM 0.4 TO 1.7. FINENESS-RATIO-2.56 CYLINDER AND FINENESS-RATIO-4.0 CYLINDER WITH FLARED AFTERBODY

John C. Mc Fall, Jr. Washington, NACA, 28 Feb. 1957 48 p refs

(NACA-RM-L56L28) CFSTI: HC $2.00/MF $0.50 CSCL 01A (Declassified)

Two right circular cylinders were tested over a Mach number range and a Reynolds number range of 1×10^6 to 8×10^6 by using the rocket boosted model technique. When given a large disturbance at supersonic speeds, both the 2.56 fineness ratio cylinder and the 4.0 fineness ratio cylinder with flared afterbody damped from a large amplitude coupled motion at supersonic speeds to a low amplitude sustained oscillation at low subsonic speeds. The variation of moment coefficient with force coefficient was nonlinear, the region of most stable slope occurring at the zero force coefficient. For both cylinders the average center of pressure over the force-coefficient range of ±0.5 moved rearward with decrease in speed to subsonic Mach numbers. Although large pitching and yawing motions were observed, there were no large deviations from a ballistic trajectory. Comparison of the drag data of this test with the drag data from the wind tunnel and free flight helium gun tests indicates that the friction drag is a very small part of the total drag. The presence of the afterbody flare on the 4.0 fineness ratio cylinder causes an increase of about 20 percent of the total drag over the drag of a cylinder with no flare at low supersonic speeds.

Author

N66-33315*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EFFECTS OF BOUNDARY-LAYER SUCTION AND SPOILERS ON TRANSONIC FLUTTER DERIVATIVES FOR A MID-SPAN CONTROL SURFACE ON AN UPSWEPT WING

John A. Wyss, Robert E. Dannenberg, Robert M. Sorenson, and Bruno J. Gambucci Washington, NASA, Feb. 1960 29 p refs (NASA-TM-X-166) CFSTI: HC $2.00/MF $0.50 CSCL 01D (Declassified)

The effects of suction and spoilers on transonic sectional control surface flutter derivatives were determined in the 14-foot transonic wind tunnel for a midspan flap-type control surface on a straight wing having an aspect ratio of 3, a taper ratio of 0.6, and a wing-thickness ratio of 0.06. Flap chord extended from the 70-percent chord station to the trailing edge. Suction was applied on spanwise perforated strips on each side of the control surface for successive locations of 77.3-, 86.6-, and 95.7-percent wing chord. The spoilers were 0.3 inch high, corresponding to a height to midspan wing chord ratio of 0.006 and were located on the control at the 82-percent wing chord station. The application of suction during control surface oscillation reduced the damping at subsonic speeds and lowered the Mach number for instability. In contrast, the spoilers had a stabilizing effect at subsonic speeds.

Author

N66-33316*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SUBSONIC AERODYNAMIC CHARACTERISTICS OF PYRAMIDAL RE-ENTRY SHAPES INCORPORATING VARIABLE GEOMETRY

Fred A. Demele and Jack J. Brownson Washington, NASA, Jan. 1962 38 p refs

(NASA-TM-X-645) CFSTI: HC $2.00/MF $0.50 CSCL 01A (Declassified)

An investigation was made to determine the aerodynamic characteristics of two blunt nosed pyramidal reentry shapes with square and rectangular cross sections, respectively, and large deflectable surfaces. The tests were conducted to maximum angles of attack of 25° and angles of sideslip of 19° over a range of Mach numbers from 0.20 to 0.90 at a Reynolds number of 3.3×10^6 and at Reynolds numbers to 15×10^6 at a Mach number of 0.20. It was found that the square pyramidal model had linear lift and pitching moment curves, but had very high drag. The drag could be reduced substantially by alining the movable vertical surfaces with the airstream, but at the expense of stability. The rectangular pyramidal model also had linear lift and pitching moment curves. By proper positioning of the movable horizontal surfaces, longitudinal stability could be maintained throughout the subsonic speed range with the moment center located at 44 percent of the body length. The elevons were an effective means of providing trim change with only small reductions in lift–drag ratio. At low speeds and for a lift coefficient of 0.4, the trim lift–drag ratio was almost 4.5.

Author

N66-33317*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

STATIC STABILITY AND CONTROL CHARACTERISTICS OF TWO LARGE-DIHEDRAL RIGHT TRIANGULAR PYRAMID LIFTING REENTRY CONFIGURATIONS AT A MACH NUMBER OF 3.05

Charles F. Whitcomb and Willard E. Foss, Jr. Washington, NASA, Jul. 1960 29 refs

(NASA-TM-X-295) CFSTI: HC $2.00/MF $0.50 CSCL 01D (Declassified)

An investigation has been conducted in the 9- by 12-inch blowdown tunnel at a Mach number of 3.05 on two large dihedral right triangular pyramid models to determine the stability characteristics with and without deflection of base-mounted controls. The investigation showed that the static longitudinal stability characteristics of the two models were generally satisfactory and the characteristics for one of the models agreed well with a similar model tested at low speeds. The model with the lesser leading edge sweep and the higher aspect ratio had a lower maximum lift–drag ratio. The controls investigated on these models appear to be capable of trimming the models at lift coefficients and angles of attack in a region where decreased heat transfer occurs for vehicles of this shape. The roll effectiveness of the controls on one of the models decreases to adverse effectiveness at an angle of attack slightly above zero lift, and large adverse yawing moment coefficients occur throughout the test angle of attack range.

Author

N66-33318*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

TRANSONIC STATIC AND DYNAMIC LONGITUDINAL STABILITY CHARACTERISTICS OF A LOW-FINENESS-RATIO, BLUNTED-CYLINDER REENTRY BODY HAVING A CONVERGING-CONE AFTERBODY

Ernest R. Hillje and Albin O. Pearson Washington, NASA, May 1962 28 p refs

(NASA-TM-X-672) CFSTI: HC $2.00/MF $0.50 CSCL 01D (Declassified)

The static and dynamic longitudinal stability parameters for a low fineness ratio, blunted-cylinder reentry body having a converging truncated-cone afterbody have been measured in an 8-foot transonic pressure tunnel. Static data were taken at angles of attack from −3° to 18.3° and dynamic data at angles of attack from 0° to 14°. The dynamic tests were made with an oscillation amplitude of 2° and at reduced frequencies from 0.018 to 0.058. Reynolds number was varied from 2.04×10^6 to 4.00×10^6, and the test Mach number range extended from 0.60 to 1.20. Results show that the body possesses static longitudinal stability throughout the ranges with small areas of neutral stability. The damping-in-pitch parameter varied erratically from values of approximately 3 to −2 and was affected by Mach number, angle of attack, reduced frequency, surface condition, and Reynolds number. The oscillatory longitudinal stability parameter showed good agreement with the static pitching-moment coefficients and showed stability throughout with small areas of neutral stability near an angle of attack of 4°. Author

N66-33321*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

AERODYNAMIC CHARACTERISTICS OF A 60° SWEPT-BACK-WING AIRPLANE CONFIGURATION HAVING TAIL SURFACES LOCATED OUTBOARD OF THE WING TIPS AT MACH NUMBERS OF 2.30, 2.97, 3.51, AND 4.06

William C. Sleeman, Jr., James D. Church, and Roger H. Fournier Washington, NASA, Mar. 1960 54 p refs

(NASA-TM-X-219) CFSTI: HC $3.00/MF $0.50 CSCL 01A (Declassified)

An investigation was conducted in the unitary plan wind tunnel to determine the drag, static longitudinal and lateral stability, and longitudinal trim characteristics of an airplane configuration having tail surfaces located outboard of the wingtips. The trapezoidal wing of the model had 60° sweepback at the leading edge, an aspect ratio of 0.90, and hexagonal airfoil sections 2-1/2 percent chord thick. Longitudinal characteristics were obtained with two sizes of horizontal tails, having areas 20 and 25 percent of the wing area. Data were obtained over an angle of attack range from approximately −3° to 13° at Mach numbers of 2.30, 2.97, 3.51, and 4.06 for a Reynolds number of 2.03×10^6. Author

N66-33323*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

TRANSONIC WIND-TUNNEL MEASUREMENTS OF SOME DYNAMIC LONGITUDINAL AND DIRECTIONAL STABILITY PARAMETERS FOR A FINNED SPINNING BODY OF REVOLUTION HAVING A HIGH FINENESS RATIO

William C. Hayes, Jr. and Robert A. Kilgore Washington, NASA, Oct. 1961 20 p refs

(NASA-TM-X-594) CFSTI: HC $1.00/MF $0.50 CSCL 01A (Declassified)

Forced-oscillation tests were made at Mach numbers between 0.60 and 1.20 to determine the damping in pitch and in yaw and the oscillatory longitudinal and directional stability parameters of a finned body of revolution of high fineness ratio free to spin about the longitudinal axis. The mean angle of attack generally varied from −4° to 12°, the reduced frequency parameter from 0.0020 to 0.0192, and the spin rate from 109 to 226 radians per second. The results of the tests showed that a 40 percent increase in the basic tail-fin area increased the damping in pitch and provided a longitudinally stable configuration. This configuration also had positive damping in yaw and directional stability. Author

N66-33324*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SUPERSONIC AERODYNAMIC CHARACTERISTICS OF TRIANGULAR PLAN-FORM MODELS AT ANGLES OF ATTACK TO 90°

Lyle E. Wiggins and George E. Kastari Washington, NASA, Jul. 1961 46 p refs

(NASA-TM-X-568) CFSTI: HC $2.00/MF $0.50 CSCL 01A (Declassified)

Results are presented of an investigation of a family of triangular planform models with 75° swept leading edges tested through the angle of attack range −5° to +90° at Mach numbers of 2.94, 3.87, and 4.78 at Reynolds number 1.06×10^6. The results are in the form of aerodynamic lift, drag, and pitching moment coefficients, and lift drag ratios. Effects of apex bluntness and cross-sectional shape on the models are considered. Aerodynamic coefficients for a slab model with tip controls and trailing edge flaps and for a modified elliptic cone model with tip controls are also presented. Author

N66-33326*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

AN EXPERIMENTAL INVESTIGATION OF AERODYNAMIC EFFECTS OF AIRFOIL THICKNESS ON TRANSONIC FLUTTER CHARACTERISTICS

Robert V. Doggett, Jr., A. Gerald Rainey, and Homer G. Morgan Washington, NASA, Nov. 1959 28 p refs

(NASA-TM-X-79) CFSTI: HC $2.00/MF $0.50 CSCL 01A (Declassified)

An experimental investigation was made of the aerodynamic effects of airfoil thickness on the transonic flutter characteristics of two types of wings. The first type of wing had a rectangular, unswept plan form with circular-arc airfoil sections. The second type of wing had a swept, tapered plan form with airfoil sections. For each type of wing, different models having similar mass and stiffness properties were tested at Mach numbers from about 0.70 to 1.10. Within the range covered, it was found that an increase in airfoil thickness had a stabilizing effect in that higher fluid density was required to produce flutter at a given Mach number. Author

N66-33327*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

PRESSURE DISTRIBUTIONS ON A FLAT-PLATE DELTA WING SWEPT 65° AT A MACH NUMBER OF 5.97 AT ANGLES OF ATTACK FROM 65° TO 115° AND ANGLES OF ROLL FROM 0° TO 250° AT A 90° ANGLE OF ATTACK

Theodore J. Goldberg and James G. Hondros Washington, NASA, Aug. 1962 31 p refs

(NASA-TM-X-702) CFSTI: HC $2.00/MF $0.50 CSCL 01A (Declassified)

Pressure distributions on a flat-plate delta wing swept 65° with squared leading and trailing edges and sharp corners were measured at a Mach number of 5.97 and a Reynolds number of 2.3×10^6. Distributions were measured in chordwise directions, radially from the wing apex, and along lines parallel to the leading and trailing edges in both the angle-of-attack and roll attitudes. A nondimensionalized correlation of pressures on square-, triangular-, and circular-planfrom models at the 90° angle-of-attack position indicates that at Mach numbers of 4.95 to 8.0 the distributions are essentially the same. Author

N66-33328*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

TRANSONIC FLUTTER INVESTIGATION OF MODELS OF PROPOSED HORIZONTAL TAILS FOR THE X-15 AIRPLANE

Lou S. Young Washington, NASA, Feb. 1961 41 p refs

(NASA-TM-X-442) CFSTI: HC $2.00/MF $0.50 CSCL 01A (Declassified)

A flutter investigation at Mach numbers between 0.79 and 1.47 has been made in transonic blowdown tunnel of dynamically and elastically scaled models of the original design and of a revised design for the all-movable horizontal tail of the X-15 airplane. A third design, which was not tested in the present investigation, was finally used in the airplane. The two designs investigated herein differed only in panel mass and stiffness distributions. Both designs had a planform which was swept back and tapered, and in each case the tail panels were independently mounted and actuated. The semispan models were mounted in a sting fuselage so that the airplane stiffnesses at the panel root were simulated, with provision for changing the stiffness in pitch. The airplane-fuselage degrees of freedom were not simulated. Author

N66-33329*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

TRANSONIC FLUTTER INVESTIGATION OF MODELS OF THE X-15 AIRPLANE HORIZONTAL TAIL

Lou S. Young and Samuel R. Bland Washington, NASA, Feb. 1961 38 p refs

(NASA-TM-X-447) CFSTI: HC $2.00/MF $0.50 CSCL 01A (Declassified)

A flutter investigation of models of the sweptback, tapered, all-movable horizontal tail of the X-15 airplane was made in transonic blowdown tunnel at Mach numbers between 0.72 and 1.32. The models were dynamically and elastically scaled so that the elastic scaling included a flutter safety margin. Therefore, in order for the models to indicate an adequate safety margin for the airplane, they were required to be flutter free at dynamic pressures up to the simulated maximum dynamic pressure for the airplane. The stiffness distributions of the airplane tail panels to which the elastic scaling was applied were those calculated for a reduced skin stiffness resulting from transient aerodynamic heating. This condition occurred at a very high Mach number and altitude. During descent, as the Mach number approaches transonic values, the stiffnesses would tend to increase; therefore, the results obtained for the present models may be conservative. The results indicated that the airplane horizontal tail has the required flutter safety margin at transonic speeds. Author

N66-33336*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

LOW-SPEED INVESTIGATION OF EFFECTS OF VERTICAL TAILS ON THE STATIC STABILITY CHARACTERISTICS OF A CANARD-BOMBER CONFIGURATION HAVING A VERY THIN WING AND A SLENDER ELLIPTICAL FUSELAGE

Thomas G. Gainer Washington, NASA, Jan. 1961 24 p refs

(NASA-TM-X-436) CFSTI: HC $1.00/MF $0.50 CSCL 01A (Declassified)

An investigation has been made of the low-speed static stability characteristics of a canard-bomber configuration having a very thin wing and a slender fuselage of elliptical cross section. The wing of the model had an aspect ratio of 1.67, a taper ratio of 0.25, a sweep of the 1/4-chord line of 56.8°, and a 2-percent-thick hexagonal airfoil section. Tests were made through an angle-of-attack range of approximately −2° to 20° and over a sideslip-angle range of −4° to 10°. The model was tested with and without small and large vertical tails attached at the wing tips. Some tests were also made with the canard surfaces removed. Author

N66-33337*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

STABILITY AND CONTROL CHARACTERISTICS AT A MACH NUMBER OF 1.89 OF A LIGHTWEIGHT GLIDER REENTRY CONFIGURATION

Ross B. Robinson and M. Leroy Spearman Washington, NASA, May 1960 26 p

(NASA-TM-X-278) CFSTI: HC $1.00/MF $0.50 CSCL 22C (Declassified)

An investigation has been made in 4- by 4-foot supersonic pressure tunnel at a Mach number of 1.89 to determine the stability and control characteristics of a lightweight glider reentry vehicle for flight attitudes corresponding to conventional flight in the atmosphere at relatively low angles of attack. The configuration investigated was an all-wing design with a diamond plan form. A small fuselage was located on the top side of the wing, and twin ventral fins were attached to the lower side of the wing. The results indicated that the configuration was stable both longitudinally and directionally. The presence of twin ventral fins that were inclined to the body center line caused a negative increment in pitching moment throughout the lift range and also reduced the maximum value of lift-drag ratio considerably. The maximum trimmed value of lift-drag ratio was about 4.2. Author

N66-33338*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

MEASUREMENTS OF THE MACH NUMBER AND PRESSURE ON THE AFTERBODY OF A BLUNT-NOSED MODEL IN FREE FLIGHT AT MACH NUMBERS FROM 6.5 TO 14

Simon C. Sommer Washington, NASA, Apr. 1960 16 p refs

(NASA-TM-X-360) CFSTI: HC $1.00/MF $0.50 CSCL 01A (Declassified)

A blunt-nosed model was tested in free flight in supersonic wind tunnel at Mach numbers from 6.5 to 14 to determine the local flow properties at one position on the afterbody. It was found that the local Mach number was essentially invariant with free-stream Mach number, whereas the pressure ratio (local to free-stream static) was found to be extremely sensitive to Mach number. These data in combination with data from the Naval Ordnance Laboratory Pressurized Ballistic Range show that the pressure ratio varies from about 0.25 to 4 as Mach number is increased from about 3.5 to 14. Total drag and static stability were also measured. Author

N66-33339*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

INVESTIGATION OF HIGH-ANGLE-OF-ATTACK PERFORMANCE OF A 14° RAMP-TYPE INLET IN VARIOUS CIRCUMFERENTIAL BODY LOCATIONS, MACH NUMBER RANGE 1.6 TO 2.0

Glenn A. Mithcell and Bruce G. Chiccine Washington, NACA, 26 Jun. 1957 38 p refs

(NACA-RM-E57C12a) CFSTI: HC $2.00/MF $0.50 CSCL 01A (Declassified)

The internal flow performance of an inlet mounted in three circumferential fuselage locations and having inlet throat and fuselage boundary-layer removal was determined at angles of attack up to 20°. Results indicate a superiority of the bottom inlet location over a side or top inlet location. Improvements in side inlet performance were obtained with flow deflector plates mounted at the top side of the inlet. Substitution of a rounded approach for the original flat approach to the inlet improved

top inlet performance. Placing a canopy in front of the top inlet reduced the inlet performance at low angles of attack but improved the performance, particularly distortions, at higher angles. Author

N66-33340*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

THE AERODYNAMIC CHARACTERISTICS OF SEVERAL THICK DELTA WINGS AT MACH NUMBERS TO 6 AND ANGLES OF ATTACK TO 50°

John B. Mc Devitt and John V. Rakich Washington, NASA, Mar. 1960 111 p refs

(NASA-TM-X-162) CFSTI: HC $3.00/MF $0.75 CSCL 01A (Declassified)

An experimental investigation of the aerodynamic characteristics of several thick delta wings has been made to provide basic information that may be useful in the design of vehicles employing high angles of attack to produce high lift and high drag during atmosphere entry. The models tested consisted of a sharp elliptic cone, two blunt elliptic cones, and a flat-sided body having essentially diamond-shaped cross sections. The tests were conducted at Mach numbers from 0.6 to 6, angles of attack up to 50°, and angles of sideslip from −4° to +4°. In addition to tests of the basic body shapes, various trailing-edge and tip controls were tested on two of the basic shapes. Convenient relationships for use in the application of impact theory to arbitrary body shapes are presented and these relationships were used to estimate the aerodynamic characteristics of several of the models at hypersonic speeds. The estimated characteristics were found to compare favorably with experiment at a Mach number of 5. Author

N66-33343*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EFFECTS OF MODIFICATIONS TO A CONTROL SURFACE ON A 6-PERCENT-THICK UNSWEPT WING ON THE TRANSONIC CONTROL-SURFACE FLUTTER DERIVATIVES

John A. Wyss, Robert M. Sorenson, and Bruno J. Gambucci Washington, NACA, 2 May 1958 69 p refs

(NACA-RM-A58B04) CFSTI: HC $2.50/MF $0.75 CSCL 01A (Declassified)

Flutter derivatives were determined from pressure-cell measurements on sinusoidally oscillating control surfaces mounted on a wing having an aspect ratio of 3, wing-thickness ratio of 0.06, and taper ratio of 0.6. Control-surface configurations included aerodynamic balance, leading-edge seal, vortex generators on the wing, splitter-plate type of control surface, and superposition of triangular shaped wedges, or tetrahedra, along the control-surface chord. Mach numbers ranged from 0.6 to 1.15. Corresponding Reynolds numbers based on mean aerodynamic chord varied from 10.4 to 14.8 million. The control surface was oscillated at ±1.08° amplitude at frequencies from 5 to 30 cycles per second. Author

N66-33347*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

AN EXPLORATORY INVESTIGATION OF A TRANSPORT CONFIGURATION DESIGNED FOR SUPERSONIC CRUISE FLIGHT NEAR A MACH NUMBER OF 3

Ausley B. Carraway, Donald T. Gregory, and Melvin M. Carmel Washington, NASA, Mar. 1960 39 p refs

(NASA-TM-X-216) CFSTI: HC $2.00/MF $0.50 CSCL 01A (Declassified)

Tests were conducted in the Langley Unitary Plan wind tunnel at Mach numbers from 2.3 to 4.5, angles of attack from about −4° to 12°, and at angles of sideslip near 0° and 4°. The Reynolds number based on the wing mean aerodynamic chord was 3×10^6. The configuration is of the canard type and employs a clipped-delta wing plan form with a maximum thickness ratio of 2-1/2 percent. The engine arrangement would consist of four engines placed side by side in a package below the wing and two engines contained in the rearward portion of the fuselage. Author

N66-33349*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

FORCE AND PRESSURE-DISTRIBUTION INVESTIGATION TO HIGH ANGLES OF ATTACK ON ALL-MOVABLE TRIANGULAR AND RECTANGULAR WINGS IN COMBINATION WITH A BODY AT SUPERSONIC SPEEDS

William A. Hill, Jr. and George E. Kaattari Washington, NACA, 10 Jul. 1956 179 p refs

(NACA-RM-A56C12) CFSTI: HC $3.25/MF $1.25 CSCL 01A (Declassified)

Forces, moments, and load distributions were measured on semispan models at Mach numbers 3.36 over a wide range of body angles of attack and wing deflection. The model components consisted of a body and wing panels of triangular and rectangular plan form of various aspect ratios. Forces and moments were also measured on two full-span wing–body configurations tested at Mach numbers of 3.36, 2.44, and 1.98. The investigation includes some comparison of low-angle interference theory with experiment in order to establish the range of angles for which there is agreement. Author

N66-33362# David Taylor Model Basin, Washington, D. C.

STORE SEPARATION INVESTIGATIONS BY GRID METHOD USING WIND TUNNEL DATA

Millard J. Bamber Apr. 1966 28 p refs *Its* Aero Rept.-1107 (DTMB-2202; AD-633565) CFSTI: HC $2.00/MF $0.50

A system was developed to obtain and process wind-tunnel test data on a store in the presence of an airplane, so that the data could be used by a digital computer to predict store separation characteristics following launch. A separation was computed by the grid method using these data, for comparison with a trajectory obtained by the point prediction method. These trajectories were in good agreement. Trajectories were also analyzed to determine the effect of various separation parameters. Author

N66-33428# United Aircraft Corp., Stratford, Conn.

TABULATED SIKORSKY CH-34 BLADE SURFACE PRESSURES MEASURED AT THE NASA/AMES FULL SCALE WIND TUNNEL

J. P. Rabbott, Jr., A. A. Lizak, and V. M. Paglino 15 Jan. 1966 118 p refs

(Contract DA-44-177-AMC-53(T))

(SER-58399; AD-634952) CFSTI: HC $4.00/MF $0.75

Tests were conducted on a full scale Sikorsky CH-34 rotor blade system, instrumented to measure chordwise pressure distributions. The basic pressure measurements are presented in tabular form to make the detailed data available for possible analysis. Author (TAB)

N66-33451*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

SUPERSONIC INVESTIGATION OF EFFECTS OF CONFIGURATION GEOMETRY ON PRESSURE-COEFFICIENT AND SECTION NORMAL-FORCE-COEFFICIENT DISTRIBUTIONS FOR A TWO-STAGE LAUNCH VEHICLE

James A. Blackwell, Jr. Washington, NASA, Aug. 1966 45 p refs
(NASA-TN-D-3408) CFSTI: HC $2.00/MF $0.50 CSCL 01A

A wind-tunnel investigation was conducted over a Mach number range from 1.60 to 2.86 to determine the pressure-coefficient and section normal-force-coefficient distributions for a two-stage launch vehicle with variations in nose-cone angle and bluntness, upper-stage fineness ratio, and transition-flare angle. The Reynolds number of the investigation was 2.50×10^6 per foot (8.20×10^6 per meter), and the angle of attack varied generally from about −6° to 6° in 3° increments. Results indicate that increasing the nose-cone angle resulted in increases in the positive pressure coefficients and in the positive section normal-force coefficients over the nose cone. Variations in the pressure-coefficient and section normal-force-coefficient distributions resulting from variations in the nose-cone angle were generally restricted to the nose cone and to a region within about two upper-stage diameters downstream of the nose-cone–upper-stage juncture. Effects of blunting the nose cone on the pressure-coefficient and section normal-force-coefficient distributions appear to be generally restricted to the blunted region of the nose cone. The variations in pressure-coefficient and section normal-force-coefficient distributions resulting from varying the upper-stage fineness ratio are generally confined to the upper stage and the forward portion of the transition flare. Author

N66-33452*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

LONGITUDINAL AERODYNAMIC CHARACTERISTICS OF A TENSION SHELL ENTRY CONFIGURATION AT MACH 20

Theodore R. Creel, Jr. Washington, NASA, Aug. 1966 30 p refs
(NASA-TN D-3541) CFSTI: HC $2.00/MF $0.50 CSCL 01A

The aerodynamic characteristics of pointed and slightly blunted versions of a tension shell entry configuration were obtained at a Mach number of 20, a ratio of wall temperature to total temperature of approximately 0.1, and a Reynolds number of approximately 0.15×10^6 for an angle-of-attack range of 0° to 45°. Pressure distributions on the pointed configuration were obtained over an angle-of-attack range of 0° to 15°. The present investigation indicated that the pointed configuration was stable at all angles of attack, whereas neutral stability was exhibited at low angles of attack by the blunted configuration. Comparison with results from an earlier investigation at a Mach number of 6.74 revealed that an increase in Mach number did not affect the axial-force coefficient of the pointed configuration but decreased the stability and normal force of both configurations at low angles of attack. Increasing the Mach number increased the maximum axial-force coefficient and shifted the angle of attack at which maximum axial-force coefficient would occur on the blunted configuration. Newtonian theory predicted the pitching moments and normal forces for the present investigation with some degree of accuracy, but it yielded poor predictions for the axial force at low angles of attack for both configurations. Author

N66-33453*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

STATIC STABILITY CHARACTERISTICS OF CONE AND HALF-CONE-PYRAMID CONFIGURATIONS AT MACH 6.83

Peter T. Bernot and Bruce C. Jordan Washington, NASA, Aug. 1966 33 p refs
(NASA-TN-D-3544) CFSTI: HC $2.00/MF $0.50 CSCL 01A

The longitudinal and lateral stability characteristics of a 5° semivertex angle cone and a D-body consisting of a half-cone of 5° semivertex angle with a rectangular pyramid were determined at a Mach number of 6.83 and a Reynolds number of 1.45×10^6. These bodies were also tested in conjunction with a delta wing swept back 83.3°. The D-body configurations were tested in the flat-bottom and flat-top orientations. Effects of Reynolds number variation on the cone model were also investigated. For the 5° cone model, predictions of Newtonian theory plus skin-friction estimates were in good agreement with the experimental values of the maximum lift-drag ratio $(L/D)_{max}$ obtained at Reynolds numbers from 0.76×10^6 to 3.00×10^6. Very good agreement between measured values of minimum drag coefficient and predictions based on Kopal exact values plus skin-friction estimates was obtained. For the body-alone models, the flat-bottom D-body yielded the highest value for $(L/D)_{max}$ of 3.62. For the body-wing models, the highest value for $(L/D)_{max}$ was 3.95, obtained for the flat-bottom D-body with the wing on the bottom. Author

N66-33457*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

SUPERSONIC AERODYNAMIC CHARACTERISTICS OF A SERIES OF RELATED BODIES WITH CROSS-SECTIONAL ELLIPTICITY

Roger H. Fournier, Bernard Spencer, Jr., and William A. Corlett Washington, NASA, Aug. 1966 61 p refs
(NASA-TN-D-3539) CFSTI: HC $3.00/MF $0.75 CSCL 01A

A wind tunnel investigation is presented for determining the supersonic aerodynamic characteristics of a series of power-law bodies and of a theoretical hypersonic minimum-wave-drag body of equal length and equal volume. The Mach number range was 1.50 to 4.63, and the angle of attack was varied from approximately −4° to 28° at 0° of sideslip. Also included in the study are the effects of altering cross-sectional ellipticity for a given body while maintaining a constant longitudinal distribution of cross-sectional area. Results indicate that increasing the power-body exponent for a given value of ellipticity results in increases in the lift-curve slope at low angles of attack. For all configurations, increasing the Mach number results in large reductions in minimum drag and large increases in the maximum lift-drag ratio. A comparison of the longitudinal aerodynamic characteristics of the theoretical hypersonic minimum-wave-drag body with the series of power-law bodies indicates that, for all values of ellipticity, the lift characteristics of this body generally fell in the range noted for the power-law bodies with exponents of 0.50 and 0.66. S.P.

N66-33468# David Taylor Model Basin, Washington, D. C. Aerodynamics Lab.

LONGITUDINAL AERODYNAMIC CHARACTERISTICS OF SEVERAL HYPERSONIC AIRCRAFT CONFIGURATIONS AT A MACH NUMBER OF 6.26

John R. Krouse and Bertram K. Ellis May 1966 42 p refs *Its* Aero Rept.-1109
(DTMB-2201; AD-634562) CFSTI: HC $2.00/MF $0.50

Wind-tunnel tests were conducted at a Mach number of 6.26 to determine the longitudinal aerodynamic characteristics of several conceptual hypersonic aircraft configurations, consisting of various half-cone-cylinder bodies and double-delta wings. Effects of body volume, vehicle orientation, wing planform, and wing-tip dihedral were determined. In general, the lift-to-drag ratios of all high-wing configurations varied slightly over an angle-of-attack range of 0° to 12° reaching maximum values of roughly 3.2 near 6°. On the other hand, the lift-to-drag ratios of all low-wing configurations increased continuously with increasing angle of attack, eventually reaching maximum values of roughly 3.6 near 10°. In all cases, fuselage base drag accounted for less than 10 percent of the total drag.

For the arbitrarily chosen center-of-gravity location, all low-wing configurations were stable but unbalanced; whereas several high-wing configurations were both stable and balanced.
Author (TAB)

N66-33486*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SUPERSONIC AERODYNAMIC CHARACTERISTICS OF A SATURN IB LAUNCH VEHICLE MODEL WITH THIRD-STAGE MODIFICATIONS
Roger H. Fournier Washington, NASA, Aug. 1966 19 p refs
(NASA-TM-X-1247) CFSTI: HC $1.00/MF $0.50 CSCL 01A

A wind-tunnel investigation of a 0.0132-scale model of a Saturn IB launch vehicle was made to determine the effects of a change in third-stage cone angle and the influence of the Apollo spacecraft with escape tower on the aerodynamic characteristics in pitch. The tests were performed at Mach numbers from 1.57 to 4.63 through an angle-of-attack range from about −6° to 20°. The results indicate that a change in the third-stage cone angle of the complete configuration from 8.6° to 12.45° increased the longitudinal stability level by about 11-percent reference diameter, but resulted primarily in an increase in axial force. The increment in axial-force coefficient progressively decreased with increasing Mach number. In addition, the data indicate that should the Apollo spacecraft abort from the launch vehicle, the resulting launch configuration would undergo a considerable increase in longitudinal stability level and in axial force at all test angles of attack and Mach numbers.
Author

N66-34079*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A NOTE ON THE ABILITY TO PREDICT TRANSONIC DRAG-RISE CHANGES DUE TO MODEL MODIFICATIONS
P. Kenneth Pierpont Washington, NACA, 3 Oct. 1957 35 p refs
(NACA-RM-L57H07) CFSTI: HC $2.00/MF $0.50 CSCL 01A
(Declassified)

An experimental and analytical study was made at transonic speeds up to a Mach number of 1.43 to ascertain the ability of present calculation procedures to predict transonic drag-rise changes which result from physical model changes. The experimental data were obtained in an 8-foot transonic tunnel and an 8-foot transonic pressure tunnel at Reynolds numbers near 2×10^6. The results showed that, with the exception of a model having a relatively bluff forebody and afterbody, the use of current techniques utilizing a Fourier analysis to fit the area slope curve of the equivalent body provided estimates of transonic drag within 15 percent of the measured values for wing-body-tail configurations. When a well-shaped configuration was chosen as a basis, present calculative procedures permitted estimates of the change in drag rise which resulted from physical change in the model which were considered accurate enough to be useful for preliminary design.
Author

N66-34083*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EXPERIMENTAL INVESTIGATION OF A BODY FLARE FOR OBTAINING PITCH STABILITY AND A BODY FLAP FOR OBTAINING PITCH CONTROL IN HYPERSONIC FLIGHT
A. J. Eggers, Jr. and Clarence A. Syvertson Washington, NACA, 18 Jan. 1955 41 p refs
(NACA-RM-A54J13) CFSTI: HC $2.00/MF $0.50 CSCL 01D
(Declassified)

Experiments were conducted at Mach numbers from 3.00 to 6.25 to determine the effectiveness of a body flap as a pitch control. The flap was 1.59 body diameters long and 78° of arc in circumferential extent. It was located near the base of the test body which was stabilized by a conical flare. It was found that, at Mach numbers greater than 5, the flap became more effective as a pitch control than an all-movable wing.
Author

N66-34084*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXPERIMENTALLY DETERMINED EFFECTS OF VARYING PITCH AND CONTROL STIFFNESSES ON THE FLUTTER CHARACTERISTICS AT SUPERSONIC SPEEDS OF ALL-MOVABLE WING AND TAIL MODELS
Perry W. Hanson Washington, NASA, Mar. 1959 50 p refs
(NASA-MEMO-10-16-58L) CFSTI: HC $2.00/MF $0.50 CSCL 01D
(Declassified)

The flutter characteristics of geometrically, dynamically, and elastically scaled variable-incidence wing, all-movable horizontal tail, and vertical tail models of a proposed fighter airplane were investigated in the 9- by 18-inch supersonic flutter tunnel at Mach numbers of 1.3, 1.64, 2.0, and 2.55. The effects of varying the pitch stiffness and aileron and rudder control stiffnesses were also investigated. A proposed method of compensating for an all-movable flutter model mounting system having an inertia greater than the scaled value was evaluated.
Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N66-32941*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FLIGHT INVESTIGATION OF DYNAMIC STABILITY AND CONTROL CHARACTERISTICS OF A 0.18-SCALE MODEL OF A FAN-IN-WING VTOL AIRPLANE
Robert H. Kirby and Joseph R. Chambers Washington, NASA, Aug. 1966 34 p refs
(NASA-TN-D-3412) CFSTI: HC $2.00/MF $0.50 CSCL 01C

A flight investigation has been made to study the stability and control characteristics of a 0.18-scale model of a fan-in-wing vertical take-off and landing (VTOL) aircraft. The investigation included hovering flight, both in and out of ground effect, and fan-powered low-speed forward flight. The hovering-flight tests out of ground effect showed that the controls-fixed motions of the model without artificial stabilization consisted of unstable oscillations in pitch and roll. The model was easy to control in pitch, but was difficult to control in roll during hovering and low-speed forward flight as a result of its sensitivity to disturbances. The model required an increasing nose-down pitch trim during the early part of the fan-powered forward flight, and a pitching moment, corresponding to a nose-fan lift reversal of 12 percent, was required to trim the model at speeds above 25 knots (59 knots full scale). The model was easy to control in yaw at all airspeeds tested.
Author

N66-33020*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LOW-SPEED WIND-TUNNEL STUDIES RELATING TO PITCH-UP ON A SUPERSONIC TRANSPORT MODEL WITH A HIGH-ASPECT-RATIO VARIABLE-SWEEP WING

Vernard E. Lockwood Washington, NASA, Aug. 1966 75 p refs
(NASA-TN-D-3542) CFSTI: HC $3.00/MF $0.75 CSCL 01C

A low-speed investigation has been made to determine methods of reducing the pitch-up tendency of a high-aspect-ratio variable-sweep wing model. The model represented a three-engine arrangement of a supersonic transport configuration where two of the nacelles were mounted below the wing on pylons supported from the fuselage and a third nacelle was mounted in the vertical tail just above the fuselage. The model had a variable-sweep cambered and twisted wing and an outboard pivot location. Among the variables studied were movable wing sweep and incidence; sweep, size, and deflection of the forewing; canard size and deflection; and horizontal-tail size and deflection. Also included are the effects of fuselage nose cross-sectional shape on the lateral directional stability characteristics. Author

N66-33045# Royal Aircraft Establishment, Farnborough (England).

SOME CONSIDERATIONS ON PERFORMANCE ESTIMATION OF HELICOPTERS

Kunihisa Wada Apr. 1966 25 p refs Transl. into ENGLISH from J. Japan Soc. Aeronaut. and Space Sci. (Japan), v. 13, no. 134, Mar. 1965 p 61–68
(RAE-LIB-TRANS-1160) CFSTI: HC $1.00/MF $0.50

Several techniques are discussed for estimating helicopter performance from inadequate flight data. Simple substitutions and approximations are presented as methods of providing missing parameters from a knowledge of their variation with known ones. Examples are given to show application of these methods to estimating parasite drag area, conversion between hovering limits in and out of ground effect, and conversion between optimum climbing speed and maximum range speed. M.G.J.

N66-33114# Flying Personnel Research Committee, London (England).

THE PHYSIOLOGICAL ASSESSMENT OF THE SEAT MOUNTED OXYGEN SYSTEM FOR THE TSR.2 AIRCRAFT (NORMALAIR OP.7000)

I. Butcher, A. W. Cresswell, and J. Ernsting (RAF, Farnborough) Jan. 1965 36 p refs
(FPRC/MEMO-216) CFSTI: HC $2.00/MF $0.50

Physiological acceptability of a seat-mounted oxygen system was assessed prior to its use in actual flight by a prototype TSR .2 aircraft. Examination made at altitudes between ground and 56,000 ft. indicates that while resistance to breathing imposed by the equipment is less than that of other demand equipment in use, this resistance exceeds that which is desirable on physiological grounds. Some instability was noted in both the main and standby regulators. Oxygen concentration provided by the main regulator during heavy breathing at low altitudes was greater than the upper limit of the specifications, but nonetheless acceptable for flight use. Equipment controls were acceptable with the exception of the main-standby regulator changeover lever which can be displaced inadvertently. M.W.R.

N66-33225# General Dynamics Corp., Groton, Conn. Electric Boat Div.

THE DESIGN OF SINGLE-PROPELLER AIR CUSHION VEHICLE CONTROL CONFIGURATIONS Final Report

Frank J. Hannigan 25 Mar. 1966 88 p refs
(Contract NObs-92050)
(U411-66-003; AD-633862) CFSTI: HC $3.00/MF $0.75

If the main thrust propeller is mounted on a rotatable pylon and is located slightly in front of the center of gravity, it can be combined with any adequate yaw-generating devices for excellent maneuvering control. Three yaw controllers produce quick turning response on the vehicle as well as allowing full use of the available side force. When a small additional propeller, either variable-pitch or rotatable, is used, sufficient yaw moment can be generated with a low horsepower engine. Roll control should be combined with each of the configurations. When roll is usable, it provides a significant additional side force. Side air jets can be used for yaw control but detailed tests must be performed to determine the effect of their use on the vehicle height and roll angle. The single-forward-thrust-propeller vehicle can be designed so that it is superior in maneuverability to the vehicle with two thrust propellers aft. The general conclusion is that an extremely maneuverable single-propeller vehicle can be designed if the main thrust propeller is located close to the C.G. If it is any distance behind the C.G., maneuverability decreases. With the propeller at or slightly in front of the center of gravity, control is excellent. Author (TAB)

N66-33314*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

EFFECTS OF WING-FUSELAGE FLOW FIELDS ON MISSILE LOADS AT SUBSONIC SPEEDS

William J. Alford, Jr. Washington, NACA, 27 Jun. 1955 19 p refs
(NACA-RM-L55E10a) CFSTI: HC $1.00/MF $0.50 CSCL 01B
(Declassified)

The flow field characteristics around a swept wing airplane model at low subsonic speed are described, and the loads induced on a typical missile model while operating within these flow fields are presented. In addition, theoretical flow fields are compared with experiment and are used in first-order estimations of the resulting induced missile loads. The results showed that the flow fields in regions beneath the one-half semispan location of a swept wing airplane model can be calculated. These flow fields can then be used in first-order estimations of the loads experienced by a missile while operating in these flow fields. Author

N66-33319*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

STABILITY AND CONTROL CHARACTERISTICS AT LOW SUBSONIC SPEEDS OF AN AIRPLANE CONFIGURATION HAVING TWO TYPES OF VARIABLE-SWEEP WINGS

Bernard Spencer, Jr. Washington, NASA, Aug. 1960 99 p refs
(NASA-TM-X-303) CFSTI: HC $3.00/MF $0.75 CSCL 01D
(Declassified)

An investigation to determine the static stability and control characteristics associated with two types of variable-sweep wings mounted on a fuselage representative of current supersonic fighter airplanes was performed in a 300-MPH 7- by 10-foot tunnel. One of the wings having an outboard pivot was an advanced design of a previously tested wing which indicated small static-stability changes with changes in wing sweep. The second wing involved had a pivot-point location inside the fuselage, which may be a more desirable location from a structural standpoint. These low-speed tests indicated that by careful design of the wing and location of the outboard pivot the longitudinal stability could be maintained at essentially the same level for wing sweepback angles of 25° and 75°, thereby the conclusions previously reached with the simplified research model were substantiated. Author

N66-33320*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

STATIC LONGITUDINAL, DIRECTIONAL, AND LATERAL STABILITY AND CONTROL DATA AT A MACH NUMBER OF 0.83 OF THE FINAL CONFIGURATION OF THE X-15 RESEARCH AIRPLANE

Jim A. Penland and David E. Fetterman, Jr. Washington, NASA, Apr. 1960 82 p refs
(NASA-TM-X-236) CFSTI: HC $3.00/MF $0.75 CSCL 01D
(Declassified)

An investigation to determine the static longitudinal, directional, and lateral stability and control characteristics of the final configuration of the X-15 research airplane, configuration 3, has been carried out in an 11-inch hypersonic tunnel. The tests were made at an average Mach number of 6.83 and a Reynolds number of 640,000 based on the wing mean aerodynamic chord. Data were obtained for an angle-of-attack range from −20° to 24° at angles of sideslip of 0° and −4.5°. The horizontal-tail deflection was varied from −35° to 15°, the vertical-tail deflection from 0° to −7.5°, and the speed-brake deflection from 0° to 50°. The longitudinal stability data are referred to the stability-axis system whereas the directional and lateral stability data are referred to the body-axis system. Author

N66-33330*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

FLIGHT SIMULATED OFF-THE-PAD ESCAPE AND LANDING MANEUVERS FOR A VERTICALLY LAUNCHED HYPERSONIC GLIDER

Gene J. Matranga, William H. Dana, and Neil A. Armstrong Washington, NASA, Mar. 1962 27 p refs
(NASA-TM-X-637) CFSTI: HC $2.00/MF $0.50 CSCL 01B
(Declassified)

A series of subsonic maneuvers simulating typical off-the-pad escape and landing procedures for a vertically launched hypersonic-glider configuration was flown using a delta-wing airplane having a peak effective lift-drag ratio of 4.7. None of the required maneuvers posed any particularly difficult or taxing situations for the pilots. Circular, overhead landing patterns flown at 240 knots indicated airspeed were relatively easy to perform and resulted in touchdown longitudinal dispersions of less than ±1,200 feet. A reduction in the pilot's visibility from the cockpit did not noticeably impair his ability to navigate except when view of the area directly beneath the airplane was required. However, portions of the escape and landing maneuvers were adversely affected by the reduced visibility. Author

N66-33331*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

INVESTIGATION OF AERODYNAMIC CHARACTERISTICS OF AN AIRPLANE CONFIGURATION HAVING TAIL SURFACES OUTBOARD OF THE WING TIPS AT MACH NUMBERS OF 2.30, 2.97, AND 3.51

James D. Church, William C. Hayes, Jr., and William C. Sleeman, Jr. Washington, NACA, 23 Jun. 1958 52 p refs
(NACA-RM-L58C25) CFSTI: HC $2.50/MF $0.50 CSCL 01D
(Declassified)

A wind tunnel investigation to determine the drag, static longitudinal and lateral stability, and longitudinal trim characteristics of an airplane configuration having tail surfaces outboard of the wing tips was conducted. Data were obtained at Mach numbers of 2.30, 2.97, and 3.51 at a Reynolds number of 2.03×10^6. Included in the basic data are some effects of transition-strip density, Reynolds number, engine pack, and wing twist combined with toe-out of the vertical tails. Author

N66-33488# Advisory Group for Aerospace Research and Development, Paris (France).

RESULTS OF RECENT INVESTIGATIONS OF V/STOL CONTROL AND RESPONSE REQUIREMENTS USING VARIABLE STABILITY HELICOPTERS

D. G. Gould Oct. 1965 40 p refs
(AGARD-519) CFSTI: HC $2.00/MF $0.50

Theoretical predictions, based on a pilot-aircraft system, of root-mean-square control response, root-mean-square heading response and minimum pilot gain were found to correlate well with pilot opinion assessments of the directional control and response requirements for flight of simulated V/STOL aircraft in turbulence. The comparisons were made for two visual flight tasks, a circuit including approach and landing, and precision hovering in a simulated wind, for four values of the weathercock stability parameter. Pilot assessments of the pitch, roll and yaw control sensitivity and control power requirements for maneuvering in calm air for visual circuit and hover tasks were compared for two aircraft weighing 2,900 lb and 15,000 lb. The results did not agree with the predictions of the existing requirements for scaling control power with weight, indicating a trend opposite to that of the present recommendations. Preliminary results from this investigation, which include simulated turbulence, as well as results from previous experiments, suggest that scale effects are over-shadowed by the requirements to ensure satisfactory flight in turbulent conditions. Author

N66-33489# Advisory Group for Aerospace Research and Development, Paris (France).

PROBLEMS ASSOCIATED WITH THE PRESENCE OF WATER, SLUSH, SNOW AND ICE ON RUNWAYS

H. R. Herb 1965 65 p refs
(AGARD-500) CFSTI: HC $2.50/MF $0.75

It has always been difficult to estimate exactly the influence of the runway condition on the take-off and landing distance of airplanes. This problem has been aggravated by the jets entering the air traffic, for fast jets have high wing loadings and, therefore, high take-off and landing speeds. At high ground speeds, the runway contamination changes the value of the tire-to-surface friction coefficient. The contamination may further increase the drag in consequence of the forces required for fluid displacement. Finally, the hydrodynamic forces acting on the wheels in slush or water can, at high speeds, lift the tires completely off the ground. All these conditions have been examined thoroughly in tests and calculations. This report gives a survey on the latest investigations and on the consequences for practical flying operation which follow these results and for which appropriate safety precautions must be taken. Author

N66-33636# RAND Corp., Santa Monica, Calif.

COST-ESTIMATING RELATIONSHIPS FOR AIRCRAFT AIRFRAMES

G. S. Levenson and S. M. Barro May 1966 98 p refs
(Contract AF 49(638)-1700; Proj. RAND)
(RM-4845-PR; AD-633989) CFSTI: HC $3.00/MF $0.75

The memorandum presents a set of generalized cost-estimating relationships for estimating development and production costs of aircraft airframes. It provides estimating equations for the following cost elements; initial and sustaining engineering, development support, flight test operations, tooling provision and sustaining tooling, manufacturing labor and material, and quality control. TAB

N66-34078*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

FLIGHT MEASUREMENTS OF SOME OF THE FLYING QUALITIES AND STABILITY DERIVATIVES OF A SUPERSONIC FIGHTER AIRPLANE

Christopher C. Kraft, Jr., Milton D. Mc Laughlin, Jack A. White, and Robert A. Champine Washington, NASA, Dec. 1958 85 p refs
(NASA-MEMO-10-7-58L) CFSTI: HC $2.50/MF $0.75 CSCL 01B (Declassified)

Flight measurements were made to determine the flying qualities and some of the stability derivatives of a supersonic fighter airplane. The results are presented in the form of measured flight data and pilot opinion. The damping of the short-period longitudinal oscillations is somewhat low. The feel forces provided by the longitudinal feel system are considered good by the pilots. The longitudinal-control-system characteristics that result from the nonlinear gearing between the stick and stabilizer result in poor handling characteristics for all indicated airspeeds. The airplane has a high roll-to-yaw ratio but one which is within the present flying-qualities requirements. The pilots dislike the longitudinal trim system because of the difficulty experienced when trying to trim precisely and the overshoot which occurs when making a large or rapid trim correction. The roll performance of the airplane is considered adequate for Mach numbers below 0.9, but the performance deteriorates rapidly in the high Mach number, high-dynamic-pressure region. Author

N66-34080*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SOME CONSIDERATIONS REGARDING THE APPLICATION OF THE SUPERSONIC AREA RULE TO THE DESIGN OF AIRPLANE FUSELAGES
Richard T. Whitcomb Washington, NACA, 3 Jul. 1956 27 p refs
(NACA-RM-L56E23a) CFSTI: HC $2.00/MF $0.50 CSCL 01C (Declassified)

This paper presents certain considerations and techniques pertinent to the application of the supersonic area rule to the design of airplane fuselages. Among the more important factors considered are an extension of the rule to account for the interference effects of the wing and tail on the general flow field for asymmetrical configurations, the determination of fuselage area developments which result in approximately the minimum wave drag, and the influence of wing parameters and design Mach number on the effectiveness of fuselage shaping. Experimental results obtained with various fuselage shapes are presented to indicate the effectiveness of the application of the supersonic area rule when utilizing these considerations. Author

N66-34081*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A SUMMARY OF RESULTS OBTAINED DURING FLIGHT SIMULATION OF SEVERAL AIRCRAFT PROTOTYPES WITH VARIABLE-STABILITY AIRPLANES
Walter E. Mc Neill and Brent Y. Creer Washington, NACA, 25 May 1956 68 p refs
(NACA-RM-A56C08) CFSTI: HC $2.50/MF $0.75 CSCL 01B (Declassified)

The predicted dynamic lateral stability and handling qualities of six advanced airplane designs were simulated by means of the F6F-3 and F-86A variable-stability airplanes flown by contractor test pilots. Both lateral oscillatory characteristics and unusual dynamic behavior peculiar to given designs were simulated. Pilot opinions and experience resulting from the simulation flights, as well as descriptions of specialized test equipment and simulation techniques, are presented and discussed. Author

N66-34082*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
TRANSONIC WIND-TUNNEL INVESTIGATION OF STATIC LONGITUDINAL AND LATERAL STABILITY AND CONTROL CHARACTERISTICS AND DRAG RISE OF A REPRESENTATIVE FIGHTER AIRPLANE
P. Kenneth Pierpont Washington, NASA, Mar. 1959 140 p refs
(NASA-MEMO-12-14-58L) CFSTI: HC $3.00/MF $1.00 CSCL 01D (Declassified)

A transonic wind tunnel investigation was made of the static longitudinal and lateral stability characteristics and drag rise of a model representative of current fighter airplanes. Mach number range of the tests was from 0.60 to 1.43. Effects of body shape, wing thickness and camber, tail surface thickness, and speed-brake location on the drag and longitudinal stability were determined. Some lateral stability characteristics and control by means of either ailerons or differential stabilizer were obtained. Author

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N66-32756*# Texas Instruments, Inc., Dallas. Semiconductor–Components Div.
DESIGN, DEVELOPMENT AND DELIVERY OF ONE (1) BREADBOARD AND THREE (3) PRODUCTION UNITS OF A 75 VA INTEGRATED STATIC INVERTER Monthly Progress Report No. 11, Mar. 1966
J. P. Vergez, L. A. Hahn, L. L. Glover, and F. F. Newcomb [1966] 23 p *Its* Rept.-03-66-37
(Contract NAS8-11925)
(NASA-CR-76899) CFSTI: HC $1.00/MF $0.50 CSCL 09A

Technical progress on the design of a breadboard integrated static inverter is briefly summarized. Reports are related to minor circuit modifications to the breadboard, testing of the variable duty-cycle one shots with gold lead pattern, the potting compound for inductors and capacitors, flip-flip arrays, and power transistors. Revisions to the detailed subassembly design are illustrated. S.P.

N66-32841# Bettis Atomic Power Lab., Pittsburgh, Pa.
RIB-2—A PROGRAM TO DETERMINE RECIRCULATION AND STABILITY IN STEAM GENERATORS
J. E. Funk and J. V. Larson Apr. 1966 33 p refs
(Contracts AT(11-1)-GEN-14; NObs-78844)
(WAPD-TM-415) CFSTI: HC $2.00/MF $0.50

RIB-2 is a digital computer program which calculates the steady-state recirculation ratio and a measure of stability for a steam generator when the geometry and operating conditions are specified. The basis for RIB-2 is the SMAL program which was written to determine stability and flow-pressure drop relationships for a heated channel and the associated inlet and outlet piping. Before RIB-2 can be used, it is necessary to determine a set of equivalent parameters which relate the steam generator to the inlet piping, the channel, and the outlet piping. A method of determining these equivalent parameters, along with a sample problem, is included. Author (NSA)

N66-32943*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

A DESIGN PROCEDURE FOR THE WEIGHT OPTIMIZATION OF STRAIGHT FINNED RADIATORS

Dale W. Harris, R. J. Burian, and J. J. Ketchman (Battelle Mem. Inst.) Washington, NASA, Aug. 1966 30p refs

(NASA-TN-D-3489) CFSTI: HC $2.00/MF $0.50 CSCL 10B

Radiators for rejecting waste heat from power generators in space can be an important weight contributor to the total weight of space power systems. For the rejection of from a few hundred watts up to perhaps a few kilowatts of waste heat straight fin radiators are the most practical. In a recent study program of weight optimization of thermoelectric power generators, a technique was established which permits the rapid determination of the geometry of a minimum weight finned radiator system. From data presented in the literature, three design equations were derived which relate twelve geometric, thermal, environmental and material parameters of an idealized fin system with no base cylinder interaction. A fourth equation was derived to take into account the base cylinder interaction and to reduce the idealized design to the realistic case. Three families of curves and auxiliary tables were prepared to assist in the rapid reduction of the idealized design equations. Author

N66-33237# Cast Inst. of Tech., Cleveland, Ohio.

FLUERICS (FLUID AMPLIFICATION). 18: A FLUID-STATE DIGITAL CONTROL SYSTEM

Ralph O. Turnquist Washington, Harry Diamond Labs., 2 Feb. 1966 66 p refs

(Contract DA-49-186-AMC-79(D))

(AD-633689) CFSTI: HC $3.00/MF $0.75

The design and development of a digital-to-analog (D/A) converter suitable for use in fluid-state digital control systems are described. Design considerations are discussed, and theoretical static and dynamic analyses are presented. Experimental static and dynamic test results are also included. The design of input data handling techniques suitable for fluidstate digital control systems is described. These techniques include a counter preset device for applying step inputs and a synchronizer necessary when applying ramp inputs. Models of both devices performed satisfactorily. The D/A converter and input data handling devices were combined with an existing quantizer, bidirectional counter, preamplifier, power amplifier, and prime mover to form a prototype digital pulse-data control system. An analysis of the effect of system parameters on performance is presented. Experimental test results are also included. A relatively simple digital lead compensation scheme was implemented. Experimental test results showed that this type of compensation can be used effectively to stabilize fluid-state digital control systems. Author (TAB)

N66-33388*# Brown Univ., Providence, R. I. Div. of Engineering.

PHOTOVOLTAIC EFFECT AND UTILIZATION OF PHOTOVOLTAIC CELLS: EFFECT OF SUB-THRESHOLD ELECTRON RADIATION ON SURFACE PROPERTIES OF Ge P-V CELLS Second Semiannual Report, 1 Nov. 1965-31 May 1966

T. J. Loferski, W. Giriat, and I. Kasai Jun. 1966 32 p refs

(Grant NGR-40-002-026)

(NASA-CR-77042) CFSTI: HC $2.00/MF $0.50 CSCL 10A

The effect of high energy electron irradiation on the surface recombination properties of germanium p-n junction photovoltaic cells made by alloying appropriate impurities into wafers of various resistivities was investigated. The experiment was carried out with 250 keV electrons. This energy is well below the threshold energy for bulk damage in Ge (350 keV). It was found that the photovoltaic short circuit current had a strong dependence on integrated electron flux, on the time elapsed since the last irradiation, i.e. on the past history of the irradiated surface, on the pressure in the vessel in which the irradiation was performed, and on the resistivity of the material exposed to the electrons. For example, if the electrons were incident on the surface of 0.1 ohm cm n-Ge, the short circuit current I_s (which was inversely proportional to the surface recombination velocity for the geometry of the cells) decreased by an order of magnitude after exposure to about 1200 μcoul/cm^2 (7.5×09^{15} electrons/cm^2). Irradiation to higher fluxes did not lead to any additional changes, i.e. the effect had saturated. The relation between the experimentally observed changes and changes in more fundamental properties of the surface is discussed. Author

N66-33403*# Rice Univ., Houston, Tex. Dept. of Electrical Engineering.

A DISTRIBUTED PARAMETERS MODEL FOR SOLAR CELLS

F. M. Stuber and G. C. Jain [1966] 22 p refs

(Grant NsG-6)

(NASA-CR-77027) CFSTI: HC $1.00/MF $0.50 CSCL 10A

The distributive circuit element model consists of a chain of T elements. The elemental model is made up of series and shunt paths. The sheet resistance of the diffused layer constitutes the series path. The shunt paths are three-fold, consisting of the diode together with a series resistance, a conductance and a light generated current source. For a given cell, the parameters used in the model can be obtained by measuring the potential profiles for reverse-biased, forward-biased and short-circuited illuminated conditions and feeding the data obtained from the measurements in the solution of the differential equations for the model. The model has been successfully employed to compute optimum gridding for the cell.

Author

N66-33505*# General Electric Co., Cincinnati, Ohio. Space Power and Propulsion Section.

DEVELOPMENT OF ELECTRICAL SWITCHGEAR FOR SPACE NUCLEAR ELECTRICAL SYSTEMS Quarterly Progress Report No. 6, Mar. 4-Jun. 4, 1966

A. H. Powell, ed. [1966] 78 p

(Contract NAS3-6467)

(NASA-CR-72014) CFSTI: HC $2.50/MF $0.75 CSCL 09A

Assembly of the first breaker and contactor was completed, the units were installed in the ultra-high vacuum test tank, and testing was initiated. The heat run and high potential check was completed, and the endurance test started, with full rated current flowing in the switchgear. The leak which developed in the ceramic capsules was subsequently reduced by use of a sealing fluid to the point where the attached ion pump would maintain the vacuum while under room conditions. Therefore, two capsules were used to complete the ac breaker and dc contactor for the heating and endurance tests. At the same time, the leak problem was reviewed in detail and the design was modified to improve the joints between the ceramic and metal spinning. New ceramic seal assemblies were ordered for use in the subsequent interruption tests. Author

N66-33611# ESSO Research and Engineering Co., Linden, N. J. Process Research Div.

HYDROCARBON-AIR FUEL CELL Semiannual Report No. 4, 1 Jul.-31 Dec. 1965

Carl E. Heath, Hugh H. Horowitz, Barry L. Tarmy, Charles E. Morrell, James A. Wilson et al [1965] 272 p refs /ts Rept.-8

(Contract DA-36-039-AMC-03743(E); ARPA Order 247)

(PcRD-2MGR-66; AD-634078) CFSTI: HC $6.00/MF $1.50

Work on the direct hydrocarbon electrode has continued to concentrate on studies of mechanism, catalysis and structure, aimed at improving the utilization of platinum or finding non-noble substitutes for it. Butane adsorption measurements were also made in phosphoric acid at 140° to determine whether the higher temperature might not lead to stronger adsorption. It was found that adsorbed butane did cover a higher fraction of the sites available to hydrogen at the higher temperature. TAB

N66-33614# Army Electronics Labs., Fort Monmouth, N. J.
LOW-COST, HIGH-ENERGY CATHODES FOR MAGNESIUM PERCHLORATE BATTERIES
Achille L. Almerini Apr. 1966 22 p refs
(ECOM-2594; AD-634100) CFSTI: HC $1.00/MF $0.50

Mercuric oxide cathodes on expanded silver grids have proven their effectiveness in magnesium/magnesium perchlorate reserve type batteries. However, high cost and the critical category of both mercury and silver compounds led to investigations on establishing a low-cost, high-energy depolarizer on an inexpensive grid to replace the mercuric oxide on silver cathode. The report presents findings and preliminary room temperature discharge data at a medium (two-hour) rate primarily for three materials: manganese dioxide, cupric oxide and meta-dinitrobenzene. Data is also presented on various halide depolarizers which did not prove to be nearly as promising. It appears that especially m-dinitrobenzene and manganese dioxide can be developed to the point where they will surpass the performance of mercuric oxide in paractical cells. This, coupled with their low cost, would make possible the development of a much needed, inexpensive, highly efficient expendable battery for operation from −40°F to +125°F for modern communication applications. Author (TAB)

N66-33621# Union Carbide Corp., Parma, Ohio. Research Lab.
THIN FUEL CELL ELECTRODES Final Report, 1 May 1965–30 Apr. 1966
M. B. Clark and K. V. Kordesch [1966] 121 p *Its* Rept.-8
(Contract DA-28-043-AMC-01344(E))
(ECOM-01344-F; AD-634077) CFSTI: HC $4.00/MF $0.75

Fifteen, 100-watt (nominal), hydrogen-air batteries were built and subjected to various load and environmental conditions. The results now allow us to predict the performance and life expectancy of such batteries. Current densities as high as 100-ASF continuous loading could be supported without electrode damage. Of particular interest was the study of the interdependence of air humidity, gas flow rates, temperature, electrolyte concentration, and current density. The effects of incomplete-CO_2 removal from the air, the differences between KOH and NaOH as electrolyte, and the characteristics of oxygen and air operation were determined. Optimum steady-state conditions for longest life were outlined, and it was shown that this type of battery is capable of extended operation with a minimum of maintenance. The uniformity of multicell batteries was carefully checked, and is discussed in detail.
Author (TAB)

N66-33807# AiResearch Mfg. Co., Phoenix, Ariz.
SUMMARIZING CONTROL SYSTEM DEVELOPMENT, CONTAMINATED-FUEL PROGRAM
26 May 1966 245 p
(Contract NOw-63-0790-c)
(CA-5224-R; AD-634102) CFSTI: HC $6.00/MF $1.25

The control system was developed considering primarily multifuel capability and tolerance to unfiltered contaminated fuel. Torque and speed were selected as the engine power parameters in multifuel capability design considerations. In a study of engine power accuracy comparisons, both compressor pressure ratio and engine torque were considered. Results indicated the superiority of torque sensing to be within 2.5% at the maximum power condition, compared to 12% using compressor pressure ratio sensing. It was decided to schedule fuel flow to the engine near the value required for the power setting. The design concept divides the control into a computer section operating in oil, and a fuel-insertion section, which has the only components subjected to contaminated fuel. Contamination and fuels testing, and pump evaluation are discussed. N.E.N.

N66-33866# New York Univ., N. Y. Dept. of Chemistry.
A ROTATING DISC THERMOCELL. II: EXPERIMENTAL
B. R. Sundheim and W. Sauerwein 15 May 1966 20 p refs
(Contract Nonr-285(37))
(AD-633736) CFSTI: HC $1.00/MF $0.50

A thermocell consisting of a rotating disc electrode and another wire electrode in an electrolytic solution is described. The temperature difference is produced by mounting a heater inside the rotating disc electrode while the temperature of the bulk solution is kept constant at a mean temperature of 21°C. The change of the thermoelectric power for 0.1 and 1.0 N aqueous KCl solution with Ag/AgCl electrodes was independent of the speed of rotation below 375–400 rpm (laminar flow range). At speeds >400 rpm the thermoelectric power values became dependent on the rotation speed, presumably because of increasing turbulence of the liquid. In the laminar flow range the mean values were 185 MV/deg and 250 MV/deg for 1.0 and 0.1 N aqueous KCl solutions, respectively. Author (TAB)

N66-33978*# General Electric Co., Cincinnati, Ohio. Space Power and Propulsion Section.
RANKINE CYCLE TEST FACILITY STUDY: TECHNICAL DATA Final Report
R. H. Wettach, ed. Aug. 1966 505 p refs
(Contract NASw-943)
(NASA-CR-54972) CFSTI: HC $5.54/MF $2.50 CSCL 10B

Requirements of a facility to be used for testing liquid metal Rankine cycle components were analyzed in a preliminary study. Study areas included: (1) vacuum environmental requirements, (2) loop and facility materials, (3) loop design, (4) conversion of a space power chamber for testing of the facility, (5) instrumentation needed, (6) loop start-up procedure, and (7) conditions (electrical output, fluid temperature, loop fluid, etc.) for the testing. Results of the study indicate that the design and construction of a 15 megawatt (thermal) test facility consisting of three liquid metal loops (a primary lithium liquid loop in which the lithium is heated to 2200°F, a secondary potassium vapor working loop in which the vapor is generated at 2050°F, and a NaK liquid radiator loop in which the liquid is heated to 1395°F) is feasible and entirely within the present day state of the art and capability of industry. The conversion of the space chamber for the testing of the facility is also considered feasible. Problem areas are discussed. FS-85 niobium alloy is recommended as the liquid metal containment material. The total time required to design build and install the facility is estimated at 48 months. A schedule is given. In addition, specifications for materials, equipment, procedures, and assemblies are given. L.S.

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N66-32686# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

BASIC QUESTIONS OF THE ELECTROPHYSIOLOGY OF THE CENTRAL NERVOUS SYSTEM COLLECTION OF ARTICLES

A. F. Makarchenko, ed. 21 Feb. 1966 248 p refs Transl. into ENGLISH of the book "Osnovnyye Voprosy Elektrofiziologii Tsentral'noy Nervnoy Sistemy" 1 Kiev, Izd. AN UKR. SSR, 1962 p 1-232
(FTD-MT-65-210; TT-66-61264; AD-633030) CFSTI: HC $6.00/MF $1.25

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1. GENERAL QUESTIONS OF THE ELECTROPHYSIOLOGY OF THE NEURON P. G. Kostyuk p 1-26 refs (See N66-32687 19-04)

2. ELECTROPHYSIOLOGY OF RETINA NEURONS A. L. Byzov p 27-38 refs (See N66-32688 19-04)

3. ELECTROPHYSIOLOGY OF NEURONS OF THE SPINAL GANGLIONS OF FROGS A. A. Lev p 39-74 refs (See N66-32689 19-04)

4. PRIMARY RESPONSES OF THE CORTEX OF THE CEREBRAL HEMISPHERES A. I. Roytbak p 75-99 refs (See N66-32690 19-04)

5. CERTAIN PECULIARITIES OF INITIATED ELECTRICAL POTENTIALS OF THE CORTEX OF THE LARGE HEMISPHERES V. V. Artem'yev p 100-113 refs (See N66-32691 19-04)

6. SECONDARY BIOELECTRIC REACTIONS OF THE CORTEX OF THE LARGE HEMISPHERES K. M. Kullanda p 114-161 refs (See N66-32692 19-04)

7. NATURE OF BACKGROUND RHYTHMICS OF THE CORTEX OF THE LARGE HEMISPHERES Ye. N. Sokolov p 162-196 refs (See N66-32693 19-04)

8. CERTAIN FACTORS DETERMINING CHANGES OF RHYTHMS OF ELECTROENCEPHALOGRAMS Yu. G. Kratin p 197-209 refs (See N66-32694 19-04)

9. MECHANISMS OF CHANGE OF BACKGROUND RHYTHMICS OF LARGE HEMISPHERES L. A. Novikova p 210-240 refs (See N66-32695 19-04)

N66-32687# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

GENERAL QUESTIONS OF THE ELECTROPHYSIOLOGY OF THE NEURON

P. G. Kostyuk *In its* Basic Questions of the Electrophysiology of the Central Nervous System 21 Feb. 1966 p 1-26 refs (See N66-32686 19-04) CFSTI: HC $6.00/MF $1.25

The general properties and different electrical activities of neurons are discussed with emphasis on the nature of electrical polarization and the electric activity of a nerve cell. The nerve cell is regarded as a mechanism of synaptic action that reacts differently to exciting and inhibiting phases where a section of the cell's region of axon exit generates the first impulse. Data on inhibition in motor neurons seem to be connected with a selective increase of their membrane permeabilities to potassium and chlorine ions. Electrophysiological properties of brain neurons include a predisposition of interneurons to stable rhythmic activity and to generation of high-frequency discharges at low thresholds of synaptix excitability. G.G.

N66-32688# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ELECTROPHYSIOLOGY OF RETINA NEURONS

A. L. Byzov *In its* Basic Questions of the Electrophysiology of the Central Nervous System 21 Feb. 1966 p 27-38 refs (See N66-32686 19-04) CFSTI: HC $6.00/MF $1.25

Nonpulsed signal transmission by photoreceptor rods and cones of fish and frog retinas were analyzed and compared with experimental results obtained through utilization of liquid microelectrodes. Hyperpolarization appeared in response to illumination after a rest potential of 30 to 40 millivolts, and disappeared only after the light was turned off. The height of the response depended on light intensity and attained 20 to 25 millivolts at large brightnesses; no pulsations were noticed. Electron microscopic intracell recordings of the various retina cell reactions found no potential differences between rod and cone responses to stimulation. It was concluded that the impulses were probably generated in the ganglionic cells and transmitted to the CNS by neutrons. G.G.

N66-32689# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ELECTROPHYSIOLOGY OF NEURONS OF THE SPINAL GANGLIONS OF FROGS

A. A. Lev *In its* Basic Questions of the Electrophysiology of the Central Nervous System 21 Feb. 1966 p 39-74 refs (See N66-32686 19-04) CFSTI: HC $6.00/MF $1.25

Isolated sciatic nerve preparations of frogs together with spinal ganglion pairs, kept in saturated Ringer solution, were tapped for their potential motor neuron current production by pyrex microelectrodes. Rhythmic stimulation of the nerve produced the disappearance of the S-component but rarely blocked the potential of the non-myelinized segment for intracellular leads; during extracellular tapping, the block appeared not during transition from the myelinized to the non-myelinized part of the axon, but during the approach to the soma of the cell. G.G.

N66-32690# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PRIMARY RESPONSES OF THE CORTEX OF THE CEREBRAL HEMISPHERES

A. I. Roytbak *In its* Basic Questions of the Electrophysiology of the Central Nervous System 21 Feb. 1966 p 75-99 refs (See N66-32686 19-04) CFSTI: HC $6.00/MF $1.25

Cortex reactions to a volley of impulses were studied on the basis of changes in the electrical fields during excitation of parts of the pyramidal neurons. The appearance of negative potentials in the primary response (PR) was attributed to impulsive neutron discharges from brain tissue layers IV and III; but the amplitude of the negative potential did not reflect the real quantity of excited neurons since not all had axonal connections with surface layers. Reduction of the positive potential during heightened excitability of the cortex was explained by the fact that local potentials were broken in the pyramids during acceleration and intensive discharge. G.G.

N66-32691# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CERTAIN PECULIARITIES OF INITIATED ELECTRICAL POTENTIALS OF THE CORTEX OF THE LARGE HEMISPHERES

V. V. Artem'yev *In its* Basic Questions of the Electrophysiology of the Central Nervous System 21 Feb. 1966 p 100-113 refs (See N66-32686 19-04) CFSTI: HC $6.00/MF $1.25

Initial electrical reactions from the cortex of the large hemispheres of anesthetized and nonanesthetized cat brains

showed that in both the sicipital and the motor regions complicated oscillations appeared. Sound, light, irritation of the sciatic nerve by electrical current, all caused in the sensorimotor region electrical reactions which varied in latent periods depending upon the place of registration of the potentials. It was concluded that the sensorimotor region of the cortex of the hemispheres constitutes a center of activity for different analyzers of both the external and the internal organism. G.G.

N66-32892# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SECONDARY BIOELECTRIC REACTIONS OF THE CORTEX OF THE LARGE HEMISPHERES

K. M. Kullanda *In its* Basic Questions of the Electrophysiology of the Central Nervous System 21 Feb. 1966 p 114–161 refs (See N66-32686 19-04) CFSTI: HC $6.00/MF $1.25

Non-primary induced bioelectric potentials in the cortex of large brain hemispheres (CLH), that appear after a response volley (PRV), were attributed to secondary generalized reactions of reticular stem or thalamic origin, and to those secondary local reactions associated with thalomocortical, associative cortical-cortical, secondary callosal, and early negative reactions. A brief overall review on bioelectrical response experiments with narcotized and nonnarcotized animals was given that emphasizes the difference between reticular stem stimulated responses and local responses. It was established that the electric negative response is extremely sensitive to narcosis. G.G.

N66-32893# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

NATURE OF BACKGROUND RHYTHMICS OF THE CORTEX OF THE LARGE HEMISPHERES

Ye. N. Sokolov *In its* Basic Questions of the Electrophysiology of the Central Nervous System 21 Feb. 1966 p 162–198 refs (See N66-32686 19-04) CFSTI: HC $6.00/MF $1.25

The origin of spontaneous brain rhythms and their connection with dynamic reflexes of nervous processes are studied by microelectrode measurements of electrical cortex oscillations. Various results on background rhythmics of the cortex of the large hemispheres are briefly reviewed and theories depicting slow brain waves as neuron excitation motions, and as dendritic potentials are developed. Light stimulation experiments seem to establish the slow potential as a change of the interneuron medium in reaction to an arriving irritation and thus represent reflexly adjustable oscillations of the ionic medium composition in which the nervous elements are located. It is concluded that the functional state of neurons is expressed indirectly in slow rhythmics through the properties of the homeostatic regulator of excitability in the cortex. The ionic composition of the interneuron medium affects the fineness of sensory functions and the quality of conditioned-reflex activities. G.G.

N66-32894# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CERTAIN FACTORS DETERMINING CHANGES OF RHYTHMS OF ELECTROENCEPHALOGRAMS

Yu. G. Kratin *In its* Basic Questions of the Electrophysiology of the Central Nervous System 21 Feb. 1966 p 197–209 refs (See N66-32686 19-04) CFSTI: HC $6.00/MF $1.25

Cat EEG responses to stimuli of different signal value were analyzed. The three factors that determined the change in background rhythmics were: brain structure, the current functional state of the brain, and the quality of the stimulus. The more complicated the given stimulus was, the more was the analyzer system activated and the brain reaction intensified. It was concluded that electrographic generalized reactions of the brain reflected the activity of its analyzer system. G.G.

N66-32895# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

MECHANISMS OF CHANGE OF BACKGROUND RHYTHMICS OF LARGE HEMISPHERES

L. A. Novikova *In its* Basic Questions of the Electrophysiology of the Central Nervous System 21 Feb. 1966 p 210–240 refs (See N66-32686 19-04) CFSTI: HC $6.00/MF $1.25

The role of specific and nonspecific afferent systems in the electrogenesis of cortical rhythmics was deduced from a brief literature review on electrophysical observations as expressed in the form of synchronized rhythms. These rhythmics were the propagation reactions of ganglionic formations to external influences; best delineated synchronized rhythms were obtained from the hippocampus, hypothalamus, and recticular formations. A series of electrophysical data from blind and deaf-mute persons, and from rabbit cortexes after bilateral enucleation or after visual deafferentation established that the reticular brain formation was important to fast and widely generalized changes of cortical rhythmics. Prolonged, stationary changes of the electrical cortex activity were to a large measure determined by impulsations proceeding along sensory paths and especially, to the visual analyzer. G.G.

N66-32897*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ON THE DYNAMICS OF CAPILLARIES AND THE EXISTENCE OF PLASMA FLOW IN THE PERICAPILLARY LYMPH SPACE

John T. Howe and Yvonne S. Sheaffer Washington, NASA, Aug. 1966 46 p refs Presented at the Intern. Symp. on the Human Capillary Circulation, Jamaica, West Indies, 1966 (NASA-TN-D-3497) CFSTI: HC $2.00/MF $0.50 CSCL 06P

The present paper describes the results of an analysis of a double-walled capillary model from the hydrodynamic point of view. The hydrodynamic analysis shows that even without the annulus, one can account for organ hematocrits as low as 50 percent of the large blood vessel hematocrits. But the corresponding pressure gradients fall outside the range of those cited in the literature. Moreover, without the plasma annulus one cannot readily account for those hematocrit ratios below 0.5 (actually as low as 0.35) that have been observed experimentally. However, the analysis shows that with the annulus of plasma, hematocrit ratios as low as 0.27 can be explained, and the corresponding pressure gradients fall within the range cited in the literature. Although the annulus of plasma was proposed to explain the surplus of plasma in some organs, it allows a deficit of plasma under some circumstances. The explanation lies in the dynamics. The analysis shows that for this condition the endothelium radius is only slightly larger than that of the red cells. Thus the pressure gradient can drive plasma against the low resistance of the annulus at a greater rate than it can drive cells along inside the endothelium because of the snug fit. Author

N66-32796# Joint Publications Research Service, Washington, D. C.

RECENT STUDIES IN SOVIET PHYSIOLOGY

23 Jun. 1966 46 p refs Transl. into ENGLISH from Fiziol. Zh., Akad Nauk Ukr. RSR (Kiev), v. 12, no. 2, Mar.–Apr. 1966 p 138–154, 269–276 (JPRS-36165; TT-66-32599) CFSTI: $2.00

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1. THE SIGNIFICANCE OF THE ADAPTATION TO HYPOXIA FOR THE PREVENTION OF AGING M. M. Syrotynin p 1–13 refs (See N66-32797 19-04)

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5. METHOD OF STATISTICAL ANALYSIS OF A VECTORCARDIOGRAM V. H. Povlov p 36–39 refs

N66-32797# Joint Publications Research Service, Washington, D. C.

THE SIGNIFICANCE OF THE ADAPTATION TO HYPOXIA FOR THE PREVENTION OF AGING

M. M. Syrotynin *In its* Recent Studies in Soviet Physiol. 23 Jun. 1966 p 1–13 refs (See N66-32796 19-04) CFSTI: $2.00

General information, personal observations, and statistical data concerning the longevity of people living in different regions and at various altitudes are at first given. This is followed by a discussion of hypoxia and its effects on various organs and on aging. Several examples are presented of the effects of hypoxia on physiological and neurological functions and on human reaction. It is pointed out that adaptation to hypoxia may retard premature aging. Case studies and facilities for such adaptation training in the U.S.S.R. are mentioned.

K.W.

N66-32798# Joint Publications Research Service, Washington, D. C.

GLASS MICROELECTRODES WITH METAL CONDUCTORS FOR EXTRACELLULAR RECORDING OF POTENTIALS

L. V. Reshod'ko and O. P. Vetrov *In its* Recent Studies in Soviet Physiol. 23 Jun. 1966 p 31–35 refs (See N66-32796 19-04) CFSTI: $2.00

The method of plating the glass microelectrodes, and an evaluation of the magnitude of electrode potential relative to the Ringer solution, the duration of the constant potential during chlorination and in absence of it, and the dependence of active resistance on thickness of the silver layer are given. Composition and preparation of the nitric acid of silver solution and the reducing agent solution are explained. The manner of fastening the electrodes for insertion into the solution is described, and the importance of the proper solution temperatures is pointed out. Resistance, current, and potential values of the electrodes are presented in tables and were compared with a normal calomel electrode filled with Ringer solution. The electrodes were used for irritation and diversion of acting current from Ranvier interceptors of single myelinized tissues of a frog.

K.W.

N66-32925*# Westinghouse Electric Corp., Pittsburgh, Pa. Bioengineering and Biosciences Technology Dept.

NASA CONTRIBUTIONS TO: CARDIOVASCULAR MONITORING

William J. Jones and Wyatt C. Simpson Washington, NASA, 1966 48 p refs Sponsored by NASA

(NASA-SP-5041) CFSTI: HC $2.00/MF $0.50 CSCL 06B

A survey is presented of physiological monitoring techniques as they apply to an intact human subject. Primary emphasis is placed upon the methodology involved in making physiological measurements and the sensing systems used. Major areas covered include techniques of cardiovascular monitoring, NASA technological advances, and the medical market. These major areas include discussions of blood pressure measurement by occlusion, blood pressure monitoring, non-occlusive indirect measuring methods, pulse rate, cardiac activity, blood flow rate measurements, oxygen saturation of blood, direct force balance probes, and vibrocardiography.

C.T.C.

N66-33109# United Kingdom Atomic Energy Authority, Harwell (England). Authority Health and Safety Branch.

INVESTIGATIONS OF THE ACCURACY ATTAINED IN ROUTINE FILM BADGE DOSIMETRY

W. A. Langmead and N. Adams Mar. 1966 31 p refs Presented at the 10th Ann. Meeting of the Health Phys. Soc., Los Angeles, 14–17 Jun. 1965

(AHSB(RP)-R-62)

The experiments have been performed to provide data on the accuracy attained in the routine assessment of radiation doses to personnel by means of film badges. In the first experiment, performed at the end of 1961, measurements were made by means of a pressed tin-plate badge of relatively simple design which was in general use at that time for radiation monitoring by the staff of the U.K. Atomic Energy Authority. In the second experiment, the more recently introduced AERE/RPS multifilter plastics film holder was used in the measurements. In both experiments each participating establishments for dose assessment. The results of the dose assessments obtained in the two experiments have been compared. It is shown that the AERE/RPS multi-filter film holder enables improved accuracy to be attained; the most significant improvements arise from the elimination of the over-estimates of dose obtained for some X- and gamma-ray mixtures with the earlier dosimeter as a consequence of its inability to identify a soft-radiation component as X-rays or beta-rays.

Author

N66-33115# Flying Personnel Research Committee, London (England).

PILOTS' RESPIRATION DURING A STANDARD TRAINING FLIGHT PROFILE

P. Norris (RAF, Farnborough) Sep. 1964 54 p refs

(FPRC/1230) CFSTI: HC $3.00/MF $0.50

Experiments were carried out to determine respiratory minute volumes and respiratory rates, on a series of Canberra pilots flying as near as possible the same flight profile. This included: take-off and climb to height, normal cruise conditions, instrument approaches, and asymmetric flying. An anemometer was inserted into the pilot's oxygen line in a Canberra B6 aircraft. A digital counter was connected electrically to the doll's eye blinker mechanism operated by the demand valve of the pilot's oxygen regulator. By taking readings of these two instruments every minute, it was possible to record respiratory minute volume and respiratory rate from take-off to touchdown.

Author

N66-33117# United Kingdom Atomic Energy Authority, Harwell (England). Authority Health and Safety Branch.

A REVIEW OF THE TOXICOLOGY AND POTENTIAL HAZARDS OF NATURAL, DEPLETED AND ENRICHED URANIUM

E. J. Bennellick Mar. 1966 44 p refs

(AHSB(RP)-R-58) HMSO: 6s

This report is based on a selection of published and unpublished data on uranium, its compounds, and alloys. It reviews from the standpoint of potential hazards, the main physical, chemical and nuclear properties and biological behavior of uranium. The report discusses the toxicology of uranium and also reproduces the derived working limits for exposure to

the material. Data is given on external radiation dose rates including that from processed irradiated uranium. Finally a review is given of fire and explosion hazards and criticality aspects. Author

N66-33173*# Brandeis Univ., Waltham, Mass. Graduate Dept. of Biochemistry.

STRUCTURAL AND FUNCTIONAL PROPERTIES OF THE H AND M SUBUNITS OF LACTIC DEHYDROGENASES

Thomas P. Fondy and Nathan O. Kaplan [1964] 31 p refs Submitted for Publication

(Grants NsG-375; NIH-CA-03611; Am. Cancer Soc. 6-P-776) (NASA-CR-59942) CFSTI: HC $2.00/MF $0.50 CSCL 06A

On the basis of structural characteristics, the lactic dehydrogenases (LDH's) may be divided into two basic types, the H type and the M type. The structural distinctions between these two basic types extend to their amino acid compositions, to their primary sequences as measured by comparative fingerprint patterns and immunological cross reactions, and to their temperature stabilities. In spite of the marked differences between the two types of LDH subunits, important structural similarities are retained. The H and M subunits are similar in molecular weight and shape. They possess the identical active site sulfhydryl peptide, and they can associate with LDH subunits from a wide variety of species into the hybrid forms of active LDH. The H and M subunits of LDH show distinctive catalytic properties. The M types are adapted to function at higher substrate concentrations than are the H types. The synthesis of M subunits is stimulated by low oxygen tension, whereas the synthesis of H subunits is not affected in this manner. The M type of LDH predominates in tissues that operate by a relatively anaerobic metabolism. Author

N66-33199*# National Aeronautics and Space Administration, Washington, D. C.

MEDICAL ASPECTS OF AN ORBITING RESEARCH LABORATORY. SPACE MEDICINE ADVISORY GROUP STUDY, JANUARY TO AUGUST, 1964

Sherman P. Vinograd 1966 152 p refs

(NASA-SP-86) GPO: HC $1.00; CFSTI: MF $1.00 CSCL 06S

Human reaction to aerospace medical experiments for an orbital research laboratory (ORL) is reported, and recommendations are presented for ground and life support systems. Spacecraft design, and ground-based as well as in-flight experiments, are recommended for six categories covered: hazards, atmosphere, living conditions, metabolic factors, group integrity, and medical considerations. Consideration is given to toxicological and general housekeeping problems in the spacecraft, body functions and hygiene, and illumination and work schedules; food, water, and waste requirements for metabolism; noise factors in harmonious group functioning; flight crew medical selection, and illness and injury safety monitoring; physiological system testing, including neurologic functions, and metabolic functions as related to hematology; psychological experiments on emotions, performance, reaction to frustration, and spontaneous activities. Data are included on specific spacecraft design, personnel requirements, and bioinstrumentation and laboratory facilities on the spacecraft. R.Ll.

N66-33200# Joint Publications Research Service, Washington, D. C.

USSR STUDIES ON HUMAN ACCLIMATIZATION AND OPHTHALMOLOGY

28 Jun. 1966 18 p Transl. into ENGLISH from Zdorov'ye (Moscow), no. 4, 1966 p 3–5

(JPRS-36229; TT-66-32662) CFSTI: $1.00

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N66-33201# Joint Publications Research Service, Washington, D. C.

BIO-MEDICAL PREPARATIONS FOR A MANNED LANDING ON THE MOON

In its USSR Studies on Human Acclimatization and Ophthalmol. 28 Jun. 1966 p 1–3 (See N66-33200 19-04) CFSTI: $1.00

Briefly discussed are biomedical developments of life support systems and protective, pressurized suits for use in a manned, soft landing on the moon. The significance of the Luna-9 soft landing with automatic instrumentation is reviewed in the light of future possibilities for safe impact landings to obtain data on the lunar surface, mineral resources, and cosmic, ultraviolet, and infrared radiation of lunar space. R.Ll.

N66-33202# Joint Publications Research Service, Washington, D. C.

ACCLIMATIZATION TO THE FAR NORTH

G. M. Danishevskiy *In its* USSR Studies on Human Acclimatization and Ophthalmol. 28 Jun. 1966 p 4–8 (See N66-33200 19-04) CFSTI: $1.00

Briefly outlined are special scientific centers' programs for studying the polar regions, and man's acclimatization and physiological response to extreme climatic conditions. The role played by hormones, enzymes, and vitamins in the adjustment of the human organism to changes in barometric pressure, temperature, humidity, and light intensity is mentioned. The use of body lubrication with fish fat is reported as protection against frostbite among new settlers to arctic regions, and the following procedures to acclimatize the human organism are listed: prior physical examination, establishment of a work routine, temperature regulation in living quarters, balanced nutrition, moderation in use of alcoholic beverages, avoidance of tapeworm, use of vitamin salt addition to drinking water, and participation in sports. R.Ll.

N66-33247# California Univ., San Francisco. Dept. of Neurology.

CENTRAL NERVOUS SYSTEM RESPONSE TO LOW-LEVEL X-IRRADIATION

Crawford F. Sams Dec. 1965 148 p refs

(Contract OCD-OS-62-148)

(AD-633820) CFSTI: HC $4.00/MF $1.00

An electrophysiological response of the central nervous system of dogs manifested by high-voltage, erratic spiking and bilateral asynchrony was shown to exist following low-level head-only X-irradiation of 1–100 rad. Evidence obtained in a study of possible mechanisms involved is consistent with nerve cell membrane permeability changes. Author (TAB)

N66-33257# Göteborg Univ. (Sweden). Inst. of Neurobiology.

BIOCHEMISTRY OF CNS CELLS DURING LEARNING Final Scientific Report, 1 Apr. 1965–31 Mar. 1966

H. Hyden 25 Apr. 1966 46 p refs

(Grant AF-EOAR-65-53)

(AFOSR-66-0932; AD-633982) CFSTI: HC $2.00/MF $0.50

Synthesis of rapidly labelled RNA in brain cells was studied by sucrose density gradients. After a 15 minute pulse of

3H-orotic acid in the nuclear fraction and after 30 minutes in the cytoplasmic fraction, heterogeneous RNA was found in the range of 8–12 S. After further 15 to 30 minutes the profile of the synthesized RNA was changed due to a shift of the RNA peaks to 16–30 S. The synthesis of RNA was twice as rapid in the glia as in the nerve cells. The RNA synthesized in a learning situation in neurons and glia involved in the activity leading to the behavioral change was characterized in one case by a DNA-like composition and in another case by asymmetry, high adenine values and low (G+C)/(A+U) values compared to those of ribosomal RNA. To judge by these parameters, the lost RNA synthesized in cortical and brain stem neurons and glia in learning is of a chromosomal type. A case of biochemical error involving the RNA of the glia (Parkinson's disease) is discussed. The characteristics of the lost RNA produced in the glia at an early stage of the disease are taken to reflect a release of undesirable genomic activities at a crucial period of the life cycle. TAB

N66-33280# Kentucky Univ., Lexington. Dept. of Physiology and Biophysics.

CALORIGENIC RESPONSE OF WARM-ADAPTED AND COLD-ADAPTED RABBITS TO INTRAVENOUS INFUSION OF EPINEPHRINE AND NOREPINEPHRINE Technical Report, Sep. 1962–Sep. 1963

William V. Judy, Ft. Wainwright, Alaska, Arctic Aeromed. Lab., Mar. 1966 34 p refs

(Contract AF 41(657)-380)

(AAL-TR-63-15; AD-633345) CFSTI: HC $2.00/MF $0.50

Measurements were made on 16 New Zealand and 8 Dutch breed rabbits to determine the effect of cold acclimation of the calorigenic responsiveness to epinephrine and norepinephrine. Oxygen consumption, colonic temperature, respiratory rate and blood glucose measurements were made before, during and after intravenous infusion of epinephrine (3 μg/kg/min) and norepinephrine (30 μg/kg/min). Warm-adapted rabbits (27° ±1°C) showed less increase in colonic temperature and oxygen consumption after infusion of epinephrine and norepinephrine than did cold-adapted rabbits (5° ±1°C). Blood glucose concentration increased equally in both groups after infusion of epinephrine and norepinephrine and increased after infusion was stopped. In cold-adapted groups I and III norepinephrine infusion increased oxygen consumption 3 and 13 times greater than that of warm-adapted groups I and III. In cold-adapted group II oxygen consumption did not increase notably above that of warm-adapted group II after infusion of norepinephrine. Epinephrine infusion induced an increased oxygen consumption in cold-adapted groups I and II two and five times greater than that of warm-adapted groups I and II. Cold-adapted group III showed no marked increase in oxygen consumption above that of warm-adapted group III after infusion of epinephrine. Author (TAB)

N66-33286# Naval Air Development Center, Johnsville, Pa.

DISTRIBUTION OF PULMONARY BLOOD FLOW AS AFFECTED BY TRANSVERSE (+ G_x) ACCELERATION Final Report

Frederic G. Hoppin, Jr., Elihu York, David E. Kuhl, and Richard W. Hyde 31 Dec. 1965 32 p refs

(Contract AT(30-1)-3175; Grant PHS C-4456)

(NADC-MR-6517; AD-633473) CFSTI: HC $2.00/MF $0.50

The distribution of blood flow in the pulmonary vascular bed under $+G_x$ (forward or transverse acceleration) was studied by the intravenous injection of radioactive ^{131}iodinated-macro aggregated albumin (^{131}I-MAA) in three normal subjects while they were under $+1G_x$, $+4G_x$, and $+8G_x$ on a human centrifuge. The resulting distribution of radioactivity in the lungs, representing the distribution of pulmonary blood flow at the time of injection, was assessed one to three hours later by lateral radioisotope scanning. The distribution of pulmonary blood flow was not markedly different at $+1G_x$, $+4G_x$, and $+8G_x$ despite a hydrostatic gradient in pulmonary intravascular pressures estimated to be 88 mm hg under $+8G_x$. These findings indicate that under $+G_x$ (forward or transverse acceleration) unlike $+G_z$ (headward or positive acceleration) the distribution of pulmonary blood flow is not markedly distorted, and that the regional flow of blood in the lung may not be significantly changed by high intravascular pressures. Author (TAB)

N66-33374*# Detroit Univ., Mich. Inst. of Space Biophysics.

PORPHINE-LIKE SUBSTANCES. III: SYNTHESIS BY ELECTRICAL DISCHARGE

Anton Szutka and Ronald H. Radzilowski [1964] 8 p refs Presented at the Natl. ACS Meeting, Detroit, 4–9 Apr. 1964

(Grant NsG-226-62)

(NASA-CR-60078) CFSTI: HC $1.00/MF $0.50 CSCL 06A

Electrical discharge between an electrode connected to a Tesla coil and the surface of an aqueous suspension of a mixture of pyrrole and benzaldehyde produces porphine-like substances. Among others the compound α, β,γδ-tetraphenylporphine (TPP) has been identified by: (1) Separation of the compound by the thin layer chromatographic technique using silica gel and two percent xylene in benzene as adsorbent and developing mixture respectively. (2) Visible spectra of the zinc-chelate of the compound compared with the chelate of the reference TPP. The yields of the compound in the presence of molecular oxygen, are increased over the yields obtained in runs performed under primitive atmosphere i.e. methane, ammonia and molecular hydrogen. Storage of the irradiated mixture either in benzene or as aqueous suspension increases the total yield. These results imply that the formation of porphine-like substances is abiogenically possible under primitive earth conditions. Author

N66-33376*# California Univ., Berkeley. Space Sciences Lab.

PRESENT STATUS OF THE AMINO ACID CODE

Thomas H. Jukes [1964] 25 p refs Presented at the Ann. Meeting of the Am. Dietetic Assoc., Portland, Oreg., 29 Jul. 1964 Submitted for Publication

(Grant NsG-479)

(NASA-CR-59734) CFSTI: HC $1.00/MF $0.50 CSCL 06A

Protein composition studies established that the amino acid code, also termed the genetic code, is the key by which the sequence of DNA bases adenine (cytosine, guanine, and thymine) is translated into amino acids during synthesis. It is believed that the final step in protein synthesis is directed by the ribonucleic acid (RNA) which is made up of nucleosides linked together by phosphates. Mutational changes can be induced by replacing one base with another, or by adding or deleting a base from the DNA. Unacceptable changes are quickly eliminated by the process of natural selection; at rare intervals a change takes place which improves the characteristics of its possessor and may lead to the development of new species. G.G.

N66-33382*# Brandeis Univ., Waltham, Mass. Graduate Dept. of Biochemistry.

EVOLUTION OF DEHYDROGENASES

Nathan O. Kaplan [1964] 74 p refs Submitted for Publication

(Grant NsG-375)

(NASA-CR-59967) CFSTI: HC $3.00/MF $0.75 CSCL 06A

Methods whereby the relationship among the same enzymes from different organisms can be compared are reviewed, and the significance of changes in enzyme structure during

evolution is discussed with emphasis on DPN-linked dehydrogenases. Comparative biochemical studies on enzyme amino acid sequences, catalytic characterizations with coenzyme analogs and inhibitors, immunological fixation methods, and temperature stability and electrophoresis mobility criteria of animal DPN-liked specific lactic dehydrogenases (LDH's) established that the H type LDH's in closely related species usually have similar electrophoretic migration rates. Evolutionary changes in the mammalism M type LDH are indicated by their different sensitivities to high pyruvate concentrations; strongly anaerobic M type LDH's are found in active animals which produce a great deal of lactic acid in contrast to humans, who develop an enzyme sensitive to high concentrations of pyruvate. G.G.

N66-33417*# California Univ., Los Angeles. Space Biology Lab.
RECORDING LEAF MOVEMENTS WITH A STRAIN GAUGE
T. Hoshizaki and K. Yokoyama (NASA. Ames Res. Center) [1964] 10 p Submitted for Publication
(Grants NsG-528; AF-AFOSR-246-63)
(NASA-CR-59801) CFSTI: HC $1.00/MF $0.50 CSCL 06C

A small lightweight leaf movement recording system using a strain gauge coupled to an amplifier and a recorder was fabricated, and a description of the sensing system is given. The unit was tested for temperature and voltage change effects, and errors were considered negligible. The small size of the sensing unit makes it possible to place several units on a single plant which would be placed in an orbiting capsule to study the effect of space environment on the circadian leaf movements. To test the reliability and accuracy of the system, the strain gauge unit was attached to a primary leaf of a Pinto bean, along with a kymograph attached to the same leaf. Recorded data from both sensors indicate that the maximum deviation of the strain gauge was not more than 5° from the values of the kymograph records. The gauge is now being used in experiments testing the effects of light dark cycles on the leaf movements of Pinto beans. L.S.

N66-33444*# Hazleton Labs., Falls Church, Va.
LIFE DETECTION SUBSYSTEM Progress Report No. 1
Earl Usdin and George R. Perez Jul. 1966 55 p refs
(Contract NASr-10)
(NASA-CR-77032) CFSTI: HC $3.00/MF $0.50 CSCL 06P

Efforts during this period were concerned with the development of life detection systems based on phosphate uptake and sulfur uptake together with an examination of engineering problems associated with the instrumentation of these and related experiments. Conventional phosphate assays were studied as well as an assay which measures phosphate levels in terms of counts derived from ^{14}C-labelled triethylamine. Sensitivities down to 3 micrograms/l of phosphate-P were observed in the former case, while the latter has not yet been determined. As sensitivity in measuring phosphate uptake will require a low phosphate medium, attempts were made to adapt the previous media, M9 and M11, by decreasing phosphate levels. Cell cultures are being grown in more optimal media and then subcultured in the deficient media, after a conditioning period in phosphate-free media. When a high cell population is incubated in M9 or M11 with low phosphate, a dramatic decrease in the phosphate level of the extracellular solution is observed within a few hours, indicating phosphate uptake by the cells. Engineering efforts were concerned with liquid processing systems designs, a study of the proposed single readout system, and a tentative study of photomultiplier tube selection. R.N.A.

N66-33445*# Massachusetts Inst. of Tech., Cambridge.
RESEARCH IN PSYCHOBIOLOGY
H. L. Teuber, R. Held et al [1964] 9 p refs
(Grant NsG-496)
(NASA-CR-77064) CFSTI: HC $1.00/MF $0.50 CSCL 05J

This program is being conducted to develop an understanding of behavior and its neural correlates for assessing limits of human and animal capacities for space travel, and for monitoring and control of higher functions under extreme conditions. Efforts during this period continued to center around studies of brain-behavior relationships, of perception and learning, and in comparative and developmental psychology. R.N.A.

N66-33446*# National Aeronautics and Space Administration, Washington, D. C.
AEROSPACE MEDICINE AND BIOLOGY—A CONTINUING BIBLIOGRAPHY WITH INDEXES, JUNE 1966
Jul. 1966 196 p refs
(NASA-SP-7011(26)) CFSTI: HC $1.00/MF $1.25 CSCL 06S

An annotated bibliography with indexes is presented to serve as a current abstracting and announcement medium for references on aerospace medicine and biology. Subject coverage includes biological, physiological, psychological, and environmental effects on man during and following simulated or actual flight in the earth's atmosphere or in interplanetary space. References describing similar effects on biological organisms of lower order are also included. Such related topics as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors are considered. In general, emphasis is placed on applied research, but references to fundamental studies and theoretical principles related to experimental development are also recorded. S.P.

N66-33517# Saskatchewan Univ., Saskatoon.
PRECIPITIN RESPONSE TO HUMAN SERUM BY A RABBIT POPULATION. VARIATION IN RESPONSE OF NORMAL RABBITS TO A PRIMARY SERIES OF INJECTIONS, MAY 1961–JUNE 1964
W. G. Glenn and G. Bonar Sutherland Brooks AFB, Tex., School of Aerospace Med., Apr. 1966 12 p refs
(Contract AF 41(657)-384)
(SAM-TR-66-28; AD-634142) CFSTI: HC $1.00/MF $0.50

The report details the quantitative results of precipitin production in a rabbit population of 264 animals when each animal was given the same primary injection series with comparable human serum pools and the antiserums were reacted with the homologous antigen. This empirical study will help to anticipate the range of rabbit response in more limited investigations with complex antigens. The tolerance limit calculations are very large for precipitin production when random samples (groups of 10) from a population of rabbits are injected with complex antigen mixtures. The limits indicated that one can be 95% confident that at least 95% of the groups will have a mean total antigen–antibody precipitate nitrogen between 2,400 and 5,900 μg n/ml., if analyzed as herein described. These values pertain to the sum of all precipitinogen–precipitin reactions from antigen excess through antibody excess. This large variability makes it possible to unknowingly obtain groups of 10 animals whose response is different from that experienced in other similar studies. Author (TAB)

N66-33519# School of Aerospace Medicine, Brooks AFB, Tex.
RESPONSES TO CORIOLIS STIMULATION IN FLYING PERSONNEL WITH DIFFERENT LEVELS OF PROFICIENCY, JUNE–NOVEMBER 1965

Edwin W. Moore Apr. 1966 12 p refs
(SAM-TR-66-36; AD-634406) CFSTI: HC $1.00/MF $0.50

The coriolis test, as part of physical evaluations, was administered to candidates for the Gemini program, candidates for the USAF research test pilot school, a representative cross section of Air Force pilots, and a group of nonflyers. The rates of decay of vertical nystagmic responses for the four groups were compared. A significantly different rate of decay was demonstrated between the groups. A greater amount of flying experience of the space pilot and test pilot groups resulted in a greater degree of habituation than shown by the representative cross section of Air Force pilots. All three groups of pilots demonstrated a significantly greater degree of habituation than the nonflyer group. The possible reasons for the significant differences found are discussed in terms of the stimuli presented and the habituation derived from flying experience.
Author (TAB)

N66-33542# Joint Publications Research Service, Washington, D. C.
ELECTRON MICROSCOPY OF BIOLOGICAL MACROMOLECULES
N. A. Kiselev 11 Aug. 1966 32 p Transl. into ENGLISH of Chapters I and VII from the book "Elektronnaya Mikroskopiya Bioligicheskikh Makromolekul" Moscow, Nauka Publishing House, 1965 p 5–13, 126–138, 147
(JPRS-36944; TT-66-33374) CFSTI: $2.00

The role of structural information in molecular biology is discussed, as are the organization levels and symmetry of biological macromolecules and the use of electron microscopy in their study. Electron microscopy is specifically considered for the study of ribosomes, and a brief review is included of present-day concepts related to ribosomes.
M.W.R.

N66-33543# Joint Publications Research Service, Washington, D. C.
BIOLOGICAL EFFECTS OF ULTRASOUND
S. I. Gorskhkov, O. N. Gorbunov, and G. A. Antropov 10 Aug. 1966 55 p Transl. into ENGLISH of selections from the book "Biologicheskoye Deystviye Ul'trazvuka" Moscow, Meditsina Press, 1965 p 3–40, 154–186, 196–197
(JPRS-36924; TT-66-33354) CFSTI: $2.00

The effects of ultrasound on industrial workers and possible protective measures are discussed in selections from a book entitled *Biological Effect of Ultrasound*. Data indicate that the ear is not a critical organ in the perception of ultrasound, which can be transmitted through the entire surface of the body. Experiments with animals show that local action of ultrasound produces less pronounced biological effects than whole body exposure. In man, it is possible to have only so-called local effects to the face, neck, and hands, by the use of protective clothing on other parts of the body. A general discussion is included of ultrasound as a factor of human environment.
M.W.R.

N66-33584# School of Aerospace Medicine, Brooks AFB, Tex. Aerospace Medical Div.
PAROTID FLUID URIC ACID RESPONSES TO PROBENECID ADMINISTRATION AND TO HEMODIALYSIS ON THE ARTIFICIAL KIDNEY Final Report, Sep. 1964–May 1965
Ira L. Shannon and Richard M. Freeman Apr. 1966 11 p refs
(SAM-TR-66-37; AD-634055) CFSTI: HC $1.00/MF $0.50

Two experiments were conducted to ascertain the relationship between serum and parotid fluid uric acid levels. Samples of blood and parotid fluid were collected from six healthy young adult males, both before and during a five-day period of uricosuric dosage. In the second experiment parotid fluid and blood samples were collected from two subjects undergoing hemodialysis on the artificial kidney. The experimental procedures brought about sharp decreases in serum uric acid for all subjects. A highly significant correlation was found between serum and parotid fluid levels in all instances. These results strengthen the premise that parotid fliud uric acid measurements possess diagnostic potential.
Author (TAB)

N66-33586# Virginia Univ., Charlottesville. Biochemical Lab.
ERYTHROCYTE BIOCHEMISTRY, 1 JULY 1965–30 JUNE 1966
Alfred Chanutin [1966] 72 p refs
(Grant DA-MD-49-193-65-G162)
(AD-633972) CFSTI: HC $3.00/MF $0.75

Erythrocyte enzymes; in vivo aging; glutathione; lipids; nucleotide metabolism; transport; erythrocyte preservation; glucose metabolism; components; anemias; effect of hormones; effect of hyperbaric oxygenation; osmotic fragility; effect of heavy metals; electrophoresis of erythrocytes; membrane structure.
Author (TAB)

N66-33620# Technology, Inc., San Antonio, Tex.
RESEARCH FOR OCULAR EFFECTS OF THERMAL RADIATION Final Report, 15 Jun. 1964–15 Jun. 1965
Thomas A. Alexander, Roger L. Bessey, and Earl R. Lawler, Jr. Brooks AFB, Tex., School of Aerospace Med., Dec. 1965 55 p refs
(Contract AF 41(609)-2464)
(AD-634027) CFSTI: HC $3.00/MF $0.50

To study minimal retinal burns in test rabbits, Technology Incorporated designed and fabricated a solid-state circuit to pulse a xenon light source up to 5000 amperes for one millisecond. Procedures to irradiate the rabbits and to calibrate the light source are described. Data for 1.05-millimeter-diameter minimal retinal burns were obtained. For one rabbit, this data was plotted and a theoretical equation was fitted to the curve. This data and theoretical equation can now be used for the prediction of minimal retinal burns.
Author (TAB)

N66-33630# Boston Univ., Mass. School of Medicine.
THE EFFECT OF DIPYRIDAMOLE ON THE ADENOSINE TRIPHOSPHATE LEVEL OF STORED HUMAN BLOOD Progress Report, Feb. 15–Sep. 30, 1965
John G. Gibson and Fabian Lionetti 8 Jun. 1966 29 p refs
(Contract Nonr-492(08))
(AD-634018) CFSTI: HC $2.00/MF $0.50

The addition of dipyridamole, a synthetic deaminase inhibitor at a concentration of .0001 M to human Heparin-ACD blood fortified with adenosine, resulted in an increase in ATP above control levels during storage at 4°C, rising to a maximum of 130% at five days and falling to 20% at 30 days. Aliquots of the same blood fortified with adenine, adenosine, or both incubated at 37°C for 30 hr showed levels at or slightly above the upper limit of +2 SD of normal. The addition of dipyridamole at a concentration of .0001M to similar aliquots showed significant increases in ATP above normal, rising to a maximum of 300, 350, and 400% in the aliquots fortified with adenine, adenosine, and both respectively, whereas the presence of adenine, adenosine, or both in Heparin-ACD blood did not significantly alter the rise in whole blood inorganic phosphate during incubation at 37°C for 30 hr, the addition of dipyridamole to similar aliquots depressed the level by from 20% to 30% of control values. Protection of the amino group of the adenine constituent of adenosine and AMP is a means to conserve erythrocyte ATP.
Author (TAB)

N66-33837# Naval Radiological Defense Lab., San Francisco, Calif.
INJURY ACCUMULATION IN SHEEP DURING PROTRACTED GAMMA RADIATION

G. F. Leong, N. P. Page, E. J. Ainsworth, and G. E. Hanks Mar. 1966 22 p refs
(USNRDL-TR-998; AD-633606) CFSTI: HC $1.00/MF $0.50

The study describes the injury accumulation and recovery in sheep exposed to Co^{60} gamma rays (2/3 LD50/30) at dose rates of 0.5 to 3.9 R/hr. Immediately following the protracted exposure (165 R), no injury as defined by the lethality of a second exposure could be detected for those animals exposed to gamma radiation at dose rates of 0.5 and 0.95 R/hr. However, when animals were subjected to a similar total protracted exposure but at dose rates of 1.85 and 3.9 R/hr, significant amounts of injury could be detected immediately following the protracted exposure. Approximately 75 R (45%) and 104 R (63%) of the remaining injury was detected in animals exposed at dose rates of 1.95 and 3.9 R/hr, respectively. This suggests a threshold exposure rate, probably between 1.0 and 1.85 R/hr, for injury accumulation in sheep. Further experiments to relate the size of the conditioning exposure (protracted) to injury accumulation indicate that at an exposure rate of 3.8 R/hr., injury accumulation is a linear function of the total protracted dose. Author (TAB)

N66-33684*# National Aeronautics and Space Administration, Washington, D. C.
SEPARATION OF SIMPLE SUGARS ON CELLULOSE LAYERS [TRENNUNG EINFACHER ZUCKER AUF CELLULOSE-SCHICHTEN]
A. Schweiger Aug. 1966 10 p refs Transl. into ENGLISH from J. Chromatology, v. 9, 1962 p 374–376
(NASA-TT-F-10258) CFSTI: HC $1.00/MF $0.50 CSCL 06A

Polysaccharide hydrolysates were investigated with respect to their content in sugar and uronic acids. The following motion substances were used: acetic acid, ethyl ester–pyridine–water, phenol saturated with water and isopropanol–pyridine–glacial acetic acid–water. Very small amounts of substance can be identified with the method. Author

N66-33699*# National Aeronautics and Space Administration, Washington, D. C.
THE INFLUENCE OF LOW TEMPERATURE ON THE DEVELOPMENT OF MICROORGANISMS. PART IV: THE INFLUENCE OF LOW TEMPERATURE ON THE GROWTH OF MOLDS [VLIYANIYE NIZKIKH TEMPERATUR NA RAZVITIYE MIKROORGANIZMOV. IV: VLIYANIYE NIZKIKH TEMPERATUR NA RAZVITIYE PLESNEVYKH GRIBKOV]
F. M. Chistyakov and Z. Z. Bocharova May 1966 11 p refs Transl. into ENGLISH from Mikrobiologiya (Moscow), v. 7, 1938 p 838–842
(NASA-TT-F-10145) CFSTI: HC $1.00/MF $0.50 CSCL 06H

The effect of temperatures of −8° C on the growth of various species and strains of mold on cold-storage meat and fish is discussed briefly. Tabulated data show that the delay in the appearance of visible growth is especially great shortly above the limiting temperature. Visible growth of Chaetostylum Fresenii appeared only after 13 months on wort-agar, whereas on fresh beef it appeared 8 months after inoculation and placement in cold storage. Thamnidium elegans gave no growth on fresh beef in 12 months but showed visible growth on wort-agar with 20% sugar after 54 days. Longest (441 days) and shortest (54 days) delays were observed with Oospora sp. The data show that low temperatures affect different species and strains of molds differently and that −8°C does not constitute the lower limits for development of molds. Author

N66-33709# Joint Publications Research Service, Washington, D. C.
EFFECT OF SUPER-HIGH ELECTROMAGNETIC WAVES ON MICE
V. A. Pukhov 9 Aug. 1966 9 p refs Transl. into ENGLISH from Patol. Fiziol. i Eksperim. Terapiya (Moscow), v. 9, no. 6, Nov.–Dec. 1965 p 72–73
(JPRS-36906; TT-66-33336) CFSTI: $1.00

The irradiation of mice, treated with the narcotic medinal and the stimulant caffeine, by superhigh frequency waves with a power density of 50 milliwatts/cm^2 is reported. In mice asleep under the effect of the narcotic, as well as in non-narcoticized mice, excitation was observed at the start of irradiation which subsequently changed to inhibition. The disinhibited effect of the waves was inversely proportional to the narcotic dose. Under 100, 200, and 400 mg/kg doses of medinal, the lifespan of the mice increased during irradiation, while after 30 to 150 mg/kg doses of caffeine the lifespan shortened. Hypothermia originating under the effect of medinal is cited as the apparent cause of the resistance of the central nervous system to the superhigh frequency radiation. It is concluded that under such radiation, a disinhibition of the central nervous system originates first with a subsequent increase in the duration of the narcotic effect. Artificially induced moderate inhibition of the central nervous system leads to an increased resistance to irradiation with microwaves; excitation reduces the resistance. E.A.O.

N66-33725*# National Aeronautics and Space Administration, Washington, D. C.
AN IMPORTANT STEP IN SPACE MEDICINE. SOME RESULTS OF THE EXPERIMENT ON THE COSMOS 110 SATELLITE [VAZHNYY ETAP KOSMICHESKOY MEDITSINY. NEKOTORYYE ITOGI EKSPERIMENTA NA SPUTNIKE "KOSMOS-110"]
V. N. Pravetskiy, N. N. Gurovskiy, B. B. Yegorov, and A. A. Kiselev Aug. 1966 6 p Transl. into ENGLISH from Turkm. Iskra (USSR), 19 May 1966 p 4
(NASA-TT-F-10243) CFSTI: HC $1.00/MF $0.50 CSCL 06S

Short (under 14 days) flights have shown no detrimental effect of weightlessness to the human organism, but longer tests show possible impairment to physiological functions; weakening of the cardiovascular system with shifts in body position and increased body excretion of calcium salts. Wider in-flight and post-flight testing conditions on animals in the Cosmos 110 flight greatly expanded research. Disruptions of the motor apparatus (reduced volume of muscle mass and impaired motor coordination), weight loss, increase of calcium in blood and urine, fluctuations in cardiac contraction, and gastro-intestinal upset were observed and evaluated in terms of their applicability to man. Author

N66-33726# Advisory Group for Aerospace Research and Development, Paris (France).
COLLECTED PAPERS PRESENTED AT THE TWENTY-SECOND MEETING OF THE AGARD AEROSPACE MEDICAL PANEL
Sep. 1965 543 p refs Meeting held at Fuerstenfeldbruck Air Base, West Germany, 2–6 Sep. 1965
(AGARD-CP-2) CFSTI: HC $5.93/MF $2.75

Papers on thermal and vestibular problems, psycho-physiology, cardiovascular and respiratory problems, environment, acceleration and vibration, and aeromedical research equipment are presented. For individual titles, see N66-33727–N66-33759.

N66-33727# Defence Research Medical Labs., Toronto (Ontario).
VESTIBULAR PROBLEMS IN ROTATING SPACECRAFT
K. E. Money *In* AGARD Collected Papers Presented at the 22d Meeting of the AGARD Aerospace Med. Panel Sep. 1965 p 1–8 refs (See N66-33726 19-04) CFSTI: HC $5.93/MF $2.75

Hazards to astronauts working in a rotating environment are examined. Semicircular canal stimulation, or Coriolis acceleration, can cause motion sickness, instability of body posture while moving, or a decrement in visual acuity during head movements. It is proposed that from the point of view of vestibular physiology, zero g is acceptable for long term manned space flights, however rotation rates of 3 to 5 rpm are hazardous. Evidence supporting these conclusions is given, and it is stated that if spacecraft must be rotated to solve other problems, the rotation should be slow enough to avoid vestibular problems. H.S.W.

N66-33728# Royal Air Force, Farnborough (England). Inst. of Aviation Medicine.

THE EFFECTS OF THE DIRECTION OF A LINEAR ACCELERATION VECTOR ON POST-ROTATIONAL VESTIBULAR RESPONSES IN MAN

A. J. Benson and M. A. Bodin *In* AGARD Collected Papers Presented at the 22d Meeting of the AGARD Aerospace Med. Panel Sep. 1965 p 9–22 refs (See N66-33726 19-04) CFSTI: HC $5.93/MF $2.75

Experiments were conducted to examine post rotational vestibular responses and the extent to which these are dependent on the direction of the prevailing linear acceleration vector. Particular attention was given to subjective after-sensations, because it is these which conflict with vertical cues and, in flight, may cause spatial disorientation. These experiments demonstrated that the duration of post rotational sensation and the rate of decay of post rotational nystagmus were influenced by the orientation of the subject to the gravitational acceleration, and that the magnitude of this effect differed according to whether the lateral or vertical canals were stimulated by the angular motion. The experiments are described and the implications of the experimental findings to problems of aerospace medicine are briefly discussed. H.S.W.

N66-33729# Royal Air Force, Farnborough (England). Inst. of Aviation Medicine.

MOTION SICKNESS DURING FLYING TRAINING

T. G. Dobie *In* AGARD Collected Papers Presented at the 22d Meeting of the AGARD Aerospace Med. Panel Sep. 1965 p 23–32 (See N66-33726 19-04) CFSTI: HC $5.93/MF $2.75

Tests were conducted to determine if it was possible to assess an individual's susceptibility to motion sickness and to attempt to reduce the incidence of this condition by some form of ground vestibular exercise. The simulator used in described and the cupulograms obtained are shown. The subjects were divided into groups having a history of motion sickness, those having no history of motion sickness, and those who have become acclimatized by flying experience. The data obtained seems to indicate that ground vestibular exercises may lead to the loss of less flying training time because of motion sickness. H.S.W.

N66-33734# School of Aerospace Medicine, Brooks AFB, Tex.

SERIAL SAMPLING OF PAROTID FLUID FOR 17-HYDROXYCORTICOSTEROID LEVELS AS A QUANTITATIVE ESTIMATE OF STRESS DURING FLIGHT IN HIGH-PERFORMANCE JET AIRCRAFT

B. H. Warren, I. L. Shannon, and S. D. Leverett, Jr. *In* AGARD Collected Papers Presented at the 22d Meeting of the AGARD Aerospace Med. Panel Sep. 1965 p 95–108 refs (See N66-33726 19-04) CFSTI: HC $5.93/MF $2.75

A series of experiments were conducted to measure 17-hydroxycorticosteroid levels under relatively nonstressful conditions in research to obtain indications of inflight biochemical response to stress. The results of these experiments are presented and assessed. The subjects selected for study included experienced pilots and nonpilots. It was found that steroid responses between pilots and nonpilots, while passively sitting in the rear cockpit of the aircraft, differ markedly. The 17-OHCS production of pilots fluctuates more markedly than that of nonpilots, and high levels occur during critical phases of flight. It is stated that these experiments represent a preliminary study; however, experiments of this type will allow the comparison of biochemical with bioelectronic parameters to obtain a more integrated understanding of human reactions to inflight conditions. H.S.W.

N66-33736# Bureau of Medicine and Surgery, Washington, D.C.

RECOVERY RATES WITH DESCENT FROM HYPOXIA-INDUCED PERIPHERAL VISUAL FIELD LOSS

W. L. Smith *In* AGARD Collected Papers Presented at the 22d Meeting of the AGARD Aerospace Med. Panel Sep. 1965 p 109–118 refs (See N66-33726 19-04) CFSTI: HC $5.93/MF $2.75

The loss of the peripheral visual field at altitude and recovery rates with descent were studied. A total of five subjects were measured at elapsed time intervals at 18,000 ft of altitude for determination of the magnitude of peripheral visual field loss. Results showed a substantial loss in the order of 16–17 percent at the end of the 20-minute elapsed time interval. Recovery rates were found to be rapid with measuring done at 5,000 ft after descent at 5000 fpm, and at ground-level pressures after a descent at 500 fpm to simulate letdown descent rates. Results from ground-level measurements indicated an overall terminal recovery of 14.7 percent of the original baseline visual field area. General recommendations for further studies were made. Author

N66-33737# School of Aerospace Medicine, Brooks AFB, Tex.

REGIONAL BLOOD FLOW DISTRIBUTION IN PROFOUND EXPERIMENTAL HYPOTHERMIA: A TECHNIQUE FOR DEFINITION OF BLOOD FLOW PATTERNS IN CRITICAL ORGANS DURING HIGH ACCELERATION STRESS

M. D. Turner, H. L. Stone, S. D. Leverett, Jr. *In* AGARD Collected Papers Presented at the 22d Meeting of the AGARD Aerospace Med. Panel Sep. 1965 p 125–138 (See N66-33726 19-04) CFSTI: HC $5.93/MF $2.75

Details are given on a method using needle shaped hydrogen electrodes to measure local blood flow in tissue without access to the arterial or venous supply. The method was used to study the amount of blood that perfuses the various body tissues during hypothermia in the warm blooded non-hibernator. The experimental procedure is discussed and charts which summarize the data obtained are provided. Additionally it was determined that the hydrogen gas technique was valuable in the study of blood flow distribution during exposure to accelerative stress. An experiment conducted using this technique is also briefly described. H.S.W.

N66-33738# School of Aerospace Medicine, Brooks AFB, Tex.

THE DISTRIBUTION OF PULMONARY BLOOD FLOW IN HUMAN SUBJECTS DURING ZERO-G

H. L. Stone, B. H. Warren, and H. Wagner, Jr. (Johns Hopkins Univ.) *In* AGARD Collected Papers Presented at the 22d Meeting of the AGARD Aerospace Med. Panel Sep. 1965 p 139–146 refs (See N66-33726 19-04) CFSTI: HC $5.93/MF $2.75

A method is described to measure pulmonary blood flow distribution in man, while in a zero gravity environment, using

macroaggregated human serum albumin labled with I^{131}. The weightlessness was produced by parobolic flight in a NF-100F aircraft. A shift was observed toward the apex of the lung during weightlessness which is more noticeable in the left lung field than in the right lung field. The data from these tests were compared to data obtained from subjects that were subjected to weightlessness while in a supine position. A significant upward shift of blood flow was found when the subject was in the supine position. The results of these tests are briefly discussed.
H.S.W.

N66-33739# Centre d'Essais en Vol, Bretigny-sur-Orge (France). Laboratoire de Medecine Aerospatiale.
RECENT ASPECTS OF RESPIRATORY PHYSIOLOGY DURING TRANSVERSE ACCELERATION
Ch. Jacquemin, P. Varene, J. Demange, and J. Timbal *In* AGARD Collected Papers Presented at the 22d Meeting of the AGARD Aerospace Med. Panel Sep. 1965 p 149–177 refs In FRENCH; ENGLISH summary (See N66-33726 19-04) CFSTI: HC $5.93/MF $2.75

Measurements of respiratory resistance by the interrupter technique confirm that transverse accelerations determine a restrictive respiratory syndrome without the participation of an overall obstructive syndrome. The magnitude of the restrictive syndrome tends to be reduced by a governing mechanism opposing thoractic compression. Similar facts were found both during artificial weighting down of the trunk and during respiration under negative pressure. It is stated however, that a comparison between these two situations is not justified. It is hypothesized that respiration under depression tends to be performed relatively homogeneously as a function of the way in which pressures are transmitted within the mechanical respiratory system, while transverse accelerations cause a modification to the distribution of the heterogeneous gas blood system as a function of the centrifuging. Justifications for these hypotheses are given.
H.S.W.

N66-33741# Naval Air Engineering Center, Philadelphia, Pa. Aerospace Crew Equipment Lab.
ABSORPTIONAL ATELECTASIS BREATHING 100 PER CENT OXYGEN AT SIMULATED ALTITUDE: PREVENTION USING INERT GAS
T. Turaids *In* AGARD Collected Papers Presented at the 22d Meeting of the AGARD Aerospace Med. Panel Sep. 1965 p 201–208 refs (See N66-33726 19-04) CFSTI: HC $5.93/MF $2.75

Four out of seven subjects exposed to a 100% oxygen atmosphere at 258 mmHg (5 psi), 72 hours, 380 mmHg (7.5 psi), 72 hours, or at sea level (14.7 psi) for 24 hours, developed a decrease in vital capacity, and of these four, two had evidence of atelectasis by X-ray. One of these subjects, who had twice developed atelectasis in a 100% oxygen atmosphere at 5 psi, was re-exposed to mixtures of oxygen with 30%, 5%, or 2.5% nitrogen at 5 psi. This subject consistently developed atelectasis when the nitrogen concentration was 2.5% or below, whereas no lung pathology was observed when nitrogen in the atmosphere was present at 5% or 30%. The role of inert gas in preventing the development of atelectasis is discussed.
Author

N66-33742# Institute of Aviation Medicine, Fuerstenfeldbruck (West Germany).
COMPARISON OF CARDIOVASCULAR REACTIONS ORIGINATED BY DIFFICULT HELICOPTER FLIGHT PATTERNS AND PHYSICAL WORKLOAD
E. A. Lauschner and H. W. Kirchhoff *In* AGARD Collected Papers Presented at the 22d Meeting of the AGARD Aerospace Med. Panel Sep. 1965 p 209–222 refs (See N66-33726 19-04) CFSTI: HC $5.93/MF $2.75

The results of laboratory functional testing of cardiovascular and respiratory reactions and efficiency were compared with the values obtained by telametric monitoring under difficult flying conditions to determine if and where relations exist between the results of the two methods. The subjects used in the tests were experienced helicopter pilots and data are given from ECG, pulse rate, blood pressure, and regulatory mechanism measurements. The results of both tests are compared and it was found that the conclusions drawn from the laboratory test results seem to be fully applicable to the combined stresses of actual flying.
H.S.W.

N66-33744# Aerospace Medicine Center, Rome (Italy).
BEHAVIOUR OF ARTERIAL OXYGEN SATURATION AND OF PULMONARY VENTILATION IN DOGS SUBJECTED TO $+G_x$ ACCELERATION
A. Degianti (School of Med., Rome, Italy), E. Busnengo, F. Rossanigo, and P. Rota *In* AGARD Collected Papers Presented at the 22nd Meeting of the AGARD Aerospace Med. Panel Sep. 1965 p 233–243 refs (See N66-33726 19-04) CFSTI: HC $5.93/MF $2.75

The results of 98 experiments conducted to examine the behavior of arterial saturation in oxygen and pulmonary ventilation in dogs subjected to prolonged acceleration of constant value, in the $+G_x$ axis are presented and assessed. Tables which summarize these results are provided and it was noted that diminution of the saturation in oxygen of the arterial blood in proportion to the acceleration value occurred. The peak was reached during the first minutes of the experiment. Additionally, initial apnea followed by a phase of hyperventilation, which persisted throughout the experiment and increased with the number of G, was observed. These indications are compared to those reported by previous investigators, and it is stated that the phenomenon of initial apnea merits additional investigation.
H.S.W.

N66-33745# Centre d'Essais en Vol, Bretigny-sur-Orge (France). Laboratoire de Medecine Aerospatiale.
MEDICO-PHYSIOLOGICAL INCIDENCES ON THE PILOT FOR FLIGHT PATTERNS TYPICAL OF VTOL [INCIDENCES MEDICO PHYSIOLOGIQUES SUR LE PILOTE DES CONFIGURATIONS DE VOL PROPRES AU VTOL]
R. Auffret and H. Seris *In* AGARD Collected Papers Presented at the 22d Meeting of the AGARD Aerospace Med. Panel Sep. 1965 p 245–257 In FRENCH; ENGLISH summary (See N66-33726 19-04) CFSTI: HC $5.93/MF $2.75

The mechanical complexity of VTOL operation is assessed, and it is pointed out that the procedures developed for low speed flight pose new problems for the pilot. These are in addition to such difficulties as the altitude and speed encountered in normal high performance aircraft, and the various phases of take-off, transition, and landing on a pinpoint location. Principal medico-physiological hazards to the pilots are identified as (1) the permanent breathing of 100% oxygen under pressure, due to the danger of air polution in the cabin from the exhaust gases surrounding the aircraft; (2) low frequency vibrations; and (3) the need for a safe low altitude bailout method. Areas for further research are delineated, based on flight testing of various prototypes.
M.G.J.

N66-33748# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
AEROSPACE TOXICOLOGY RESEARCH
Anthony A. Thomas *In* AGARD Collected Papers Presented at the 22d Meeting of the AGARD Aerospace Med. Panel Sep. 1965 p 259–278 refs (See N66-33726 19-04) CFSTI: HC $5.93/MF $2.75

Three major areas of aerospace toxicology research are discussed briefly. In propellant toxicology, emphasis is focused on characterizing tolerance to high level, short duration exposure, and on establishing emergency tolerance limits (ETL) for missile operators. Consideration is also given to beryllium toxicity and the differences in response of the lung tissue between various animal species. Environmental pollution research includes laboratory and greenhouse studies involving all newly synthesized propellants and combinations of fuels and oxidizers. Such propellants, propellant ingredients, and combustion products are listed, and summary data are presented on fumigation studies of hydrazine, unsymmetrical dimethylhydrazine, and nitrogen dioxide. The environmental toxicology of space cabins is also under study. Details are given on an inhalation exposure facility for determining the effects of low atmospheric pressure and oxygen rich atmospheres on the characteristics of uninterrupted long term exposure to toxic gases and vapors encountered in space cabin atmospheres. M.G.J.

N66-33747# Royal Air Force, Farnborough (England). Inst. of Aviation Medicine.

A SURVEY OF AN RAF DECOMPRESSION TEST AT 28,000 FEET

D. I. Fryer *In* AGARD Collected Papers Presented at the 22d Meeting of the AGARD Aerospace Med. Panel Sep. 1965 p 279–293 refs (See N66-33726 19-04) CFSTI: HC $5.93/MF $2.75

Approximately 5000 test records of airmen subjected to decompression tests at 28,000 feet were analyzed to determine the rate and type of failure, the individual factors involved, and the validity of the test. Symptoms are grouped according to bends, chokes, central nervous system, skin, and circulatory, with 89.1% of the total breakdowns attributed to bends. Observed and chance distribution of multiple occurrences are listed, and relationships are drawn between age and susceptibility, and weight and susceptibility. The time of onset of symptoms and the time of forced descent are plotted. Repeatability data are analyzed, and results indicate that a true individual susceptibility exists. M.G.J.

N66-33753# Aerospace Medical Div. Aeromedical Research Lab. (6571st), Holloman AFB, N. Mex.

BIOLOGICAL PARAMETERS OF IMPACT

W. K. Brown and R. F. Chandler *In* AGARD Collected Papers Presented at the 22d Meeting of the AGARD Aerospace Med. Panel Sep. 1965 p 395–407 refs (See N66-33726 19-04) CFSTI: HC $5.93/MF $2.75

The problems encountered, and the experimental approaches employed in establishing useful tolerance criteria to abrupt acceleration are discussed. Although a mathematical model which represents the dynamic system is considered necessary to understand the response of the system, only the most simple models have been investigated. This is due to the lack of definition of the physical characteristics of the body, and the complex mathematics needed to describe the dynamic reaction. The model most frequently used is a simple spring mass system, with the major elements of the biological system represented by equivalent mechanical elements. These elements appear as lumped masses in the model supported by springs and dashpots which represent the force transmission system (skeletal) and energy dissipation system (soft tissue) of the body. Details are also given on 288 human impact tests using 24 different subject orientations with respect to the force vector. The most significant physiological response was that of post-impact slowing of the heart rate. Graphical data are also included on other biological responses; these are considered promising as tolerance indicators. M.G.J.

N66-33754# Naval Air Engineering Center, Philadelphia, Pa. Aerospace Crew Equipment Lab.

PHYSIOLOGICAL ENDPOINTS IN ACCELERATION RESEARCH

Kenneth R. Coburn *In* AGARD Collected Papers Presented at the 22d Meeting of the AGARD Aerospace Med. Panel Sep. 1965 p 409–428 refs (See N66-33726 19-04) CFSTI: HC $5.93/MF $2.75

The problems inherent in creating equivalent acceleration environments on centrifuges of differing characteristics are assessed, along with the difficulties involved in creating equivalent acceleration environments for each of two subjects on the same centrifuge. The responsibility of the investigator in experimentation with human subjects is defined from the legal standpoint. Variables in the acceleration environment are considered, and it is suggested that coordinates with reference to the centrifuge car or carriage be used in determining a fixed location for a central reference transducer. The importance of locating the body in a consistent manner in reference to the centrifuge geometry is stressed, along with the need of certain anthropomorphic measurements of each subject. The theory of endpoints is reviewed, and auditory phenomena, electroencephalography, visual, and cardiorespiratory endpoints are discussed. Examples are included to indicate the degree of difference which exists between two subjects experiencing grey-out and black-out. M.G.J.

N66-33764*# National Aeronautics and Space Administration, Washington, D. C.

CHANGES IN APPETITE FOR WATER, GLUCOSE, SODIUM, AND POTASSIUM IN RATS WHEN THE SODIUM PUMP IS INHIBITED BY STROPHANTHIN-K [IZMENENIYA APPETITA K VODE, GLYUKOZE, NATRIYU I KALIYU U KRYS PRI UGNETENII NATRIYEVOGO NASOSA VVEDENIYEM STROFANTINA K]

A. M. Ugolev and G. M. Roshchina Jun. 1966 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 165, no. 5, 1965 p 1211–1214

(NASA-TT-F-10200) CFSTI: HC $1.00/MF $0.50 CSCL 06C

It is found that strophanthin inhibits sodium appetite and stimulates potassium and water appetites. With strophanthin administration there is increased water appetite, decreased glucose consumption, decreased sodium consumption, and increased potassium consumption. Author

N66-33780# Library of Congress, Washington, D. C. Aerospace Technology Div.

THE EFFECT OF ACCELERATIONS ON THE VESTIBULAR ANALYZER Surveys of Foreign Scientific and Technical Literature

Janice L. Smith 3 Jun. 1966 29 p refs

(ATD-66-62)

This bibliography was compiled from Soviet open sources published 1955–1966 together with 5 Western sources. It is the first report in a series and deals with the effect of angular, impact, and Coriolis accelerations on the vestibular mechanism. The bibliography is divided into two sections. The first section consists of 112 items which were considered of primary interest. The second part contains 27 items considered of secondary interest because they contained elementary or background information or had only a few relevant paragraphs. Pertinent information included: diagnostic value of labyrinthine reactions, changes in the frequency spectrum of an encephalogram during vestibular and optokinetic stimulation, cortical regulation of vestibular reactions, stimulation of the vestibular apparatus of a dog, development of conditioned vestibular reflexes, biological and physiological studies in rocket and

satellite flights, physiological effects of gravitation, spatial orientation, equipment for study of the vestibular analyzer, effect of prolonged acceleration motion sickness, vestibular training. Author

N66-33825# Yale Univ., New Haven, Conn. Dept. of Biology.
POLARIZED LIGHT AND THE FUNCTIONAL ORGANIZATION OF THE COMPOUND EYE Final Report, 1 Jul. 1957–30 Jun. 1964
Talbot H. Waterman 1965 14 p refs
(Contract Nonr-609(23))
(AD-620756) CFSTI: HC $1.00/MF $0.50

The long range aim of this research program was to investigate the mechanism and biological significance of the polarized light sensitivity of arthropods first demonstrated in the honey-bee by Karl von Frisch in 1948. The operational objectives of the work naturally developed in ways which were not completely anticipated at the beginning so that three related, yet distinct, lines of research were in fact pursued under the subject contract. Their objectives were: (1) electrophysiological study of arthropod compound eyes with particular reference to their sensitivity to plane polarized light, (2) measurement of polarization of natural submarine light as well as the factors which affect it and (3) analysis of polarized light orientation (polarotaxis) in aquatic animals both in the laboratory and in the field. Author (TAB)

N66-33833# Malecki Labs., Inc., Chicago, Ill.
RESEARCH ON THE BASIS OF COLD INJURY Final Report, 1 Jan.–31 Dec. 1965
George J. Malecki and Basil J. Luyet [1965] 77 p refs Prepared in part with Am. Found. for Biol. Res.
(Contract Nonr-4764(00))
(AD-634045) CFSTI: HC $3.00/MF $0.75

The objective of the research study was to design, develop, and fabricate instruments for and to conduct studies on the effect of controlled deionization during slow freezing on viability of biological tissues. The studies included but were not limited to: (1) nature of freezing injury to living cells and, (2) employment of the instruments to study the effect of freezing on blood. Macro- and micro freeze-electrodialysis instruments were designed, fabricated, and placed into operating condition. With the macro unit, controlled deionization during slow freezing under isotonic conditions was achieved initially with a model saline system and subsequently, with blood. The micro unit was employed to observe directly under the microscope the morphology of the erythrocytes during deionization and freezing. Results obtained with the blood samples indicated that improved stability to freezing was not realized with the electrodialysis treatment. Apparently, the passage of electrical current through blood during freezing promotes hemolysis. What is believed to be a significant contribution to the area of blood preservation was achieved when it was found that definitely improved stability to freezing is obtained by separating plasma from whole blood, concentrating and partially deionizing it, and then remixing the concentrated plasma with the erythrocytes. Author (TAB)

N66-33838# School of Aerospace Medicine, Brooks AFB, Tex.
PAROTID FLUID TOTAL PROTEIN IN PATIENTS WITH UREMIA AND PROTEINURIA Final Report, Jan.–Sep. 1965
Richard M. Freeman and Ira L. Shannon Apr. 1966 10 p refs
(SAM-TR-66-41; AD-634053) CFSTI: HC $1.00/MF $0.50

Stimulated parotid fluid samples (238) were collected from 32 patients to determine if altered renal function was associated with deviations in salivary protein levels. Of the 32 patients studied, 10 were in the terminal stages of chronic renal disease, 7 were in the oliguric phase of acute tubular necrosis, and 15 had normal regnal function. There were no significant differences in parotid fluid protein concentration or minute secretion associated with the state of renal function. Author (TAB)

N66-33846# Joint Publications Research Service, Washington, D. C.
CEREBRAL VASCULAR CRISES
V. V. Utkin 12 Jul. 1966 14 p Transl. into ENGLISH from Voenno-Med. Zh. (Moscow), no. 5, 1966 p 91–94
(JPRS-36429; TT-66-32861) CFSTI: HC $1.00

A general discussion is given of cerebral vascular crises, which are defined as acute, brief disturbances of cerebral blood circulation. The discussion includes the causes, symptoms, diagnosis, and methods of cure and treatment. C.T.C.

N66-33856# Universidad Peruana de Ciencias Medicas y Biologicas, Lima (Peru). Instituto de Investigaciones de la Altura.
THE ROLE OF ADRENAL CORTEX IN THE PROCESS OF ACCLIMATIZATION TO HIGH ALTITUDES Annual Report, 1 May 1965–30 Apr. 1966
Federico Monclos Apr. 1966 20 p refs
(Contract DA-ARO-49-092-65-G89)
(Rept.-1; AD-633760) CFSTI: HC $1.00/MF $0.50

The results indicate that exposure to high altitude (4300 meters) causes a transitory increase in the adrenal cortex secretion of cortisol. The adrenal cortex can be further stimulated with exogenous ACTH during the first day of exposure to an environment of low oxygen tension. It is also possible to inhibit the adrenal cortex hyperactivity by dexamethasone administration. The biological half-life of a synthetic corticotrophin preparation was studied. Using a new formula for calculation results ranged between 19.4 and 38.7 minutes. Author (TAB)

N66-33913# Texas Univ., Austin. Environmental Health Engineering Research Labs.
RADIOACTIVITY TRANSPORT IN WATER. STRUCTURE AND METABOLISM OF A LOTIC COMMUNITY, PART I (APRIL–JULY 1964)
B. J. Copeland and E. F. Gloyna 1 Feb. 1965 62 p refs
(Contract AT(11-1)-490)
(EHE-02-6501, Pt. 1; TID-22873) CFSTI: HC $3.00/MF $0.75

The various aspects of community metabolism of animals and plants under simulated stream conditions were studied. Calculations were made of total solar input, photosynthetically available light, oxygen and carbon dioxide photosynthesis, oxygen and carbon dioxide respiration, efficiency of the ecosystem, photosynthesis/respiration ratios, and photosynthetic and respiratory quotients. The relation of community metabolism to radionuclide transport and its possible role in future considerations were evaluated. The community metabolism characteristics were at times different from those expected for flowing ecosystems. However, owing to the paucity of similar data for natural or artificial streams, it is not known whether these simulated stream values are to be considered typical or atypical. It was concluded that the relationship of photosynthesis to respiration (P/R ratios) is the prime factor in the uptake and release of ^{65}Zn and ^{60}Co in plants, water, and sediment. Carbon dioxide metabolism appeared to give the most realistic results, since oxygen metabolism values seemed to be affected by the anaerobic phase of the diurnal cycle. Author (NSA)

N66-33914# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.

ACTION SPECTRA OF THE EFFECT OF ULTRAVIOLET RADIATION ON *"IN VITRO"* DNA OF PHAGE α [SPETTRO D'AZIONE PER L'EFFETTO PRODOTTO DALLA RADIAZIONE ULTRAVIOLETTA SUL DNA DEL FAGO α IRRADIATO "IN VITRO"]

M. Cremonese 17 Nov. 1965 37 p refs In ITALIAN; ENGLISH summary
(ISS-65/45)

Action spectra of the effect of ultraviolet radiation on the physico-chemical properties of the DNA of phage α irradiated *in vitro* were obtained. Using the analytical ultracentrifuge and the spectrophotometer the following effects were studied: (a) production of interruptions in the single polynucleotide strand; (b) local denaturation; (c) presence of a fraction of molecules resistant to denaturation; (d) increase in the buoyant density of irradiated DNA. All of the action spectra thus obtained show a slight variation of the radiation efficiency in the range between 2600 and 2800 Å, and a well-defined peak at $\lambda \simeq 2880$ Å. Threshold values for all of the examined effects are 3000 Å. Author (NSA)

N66-33915# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).

ON THE RELATIONSHIP BETWEEN RADIATION RESISTANCE AND RECUPERATION ABILITY OF *ARTEMIA SALINA* OOCYTES

P. Metalli and E. Ballardin Nov. 1965 10 p refs Presented at European Soc. for Radiation Biol., Sect. Genet. Effects, Ann. Meeting, Utrecht, 16–18 Sep. 1965
(RT-B10-(65)31; CONF-650968-1)

X-ray-induced dominant (total embryonic) lethality in oocytes of *Artemia salina* shows dose-action curves with a shoulder followed by a nearly exponential relationship at high doses. It was found that the tetraploid oocytes are more radioresistant that the diploid ones, as evidenced by a slope ratio of 3 to 4. Further, the threshold is about twice as large and it was suggested that part of the damage could be repaired in all strains and that the tetraploid oocytes might enjoy a greater recuperation efficiency, besides being more resistant. This hypothesis was tested with the split-dose technique on diakinesis (or prometaphase) oocytes, which is a stage of long duration and constant peak radioresistance in all strains. The results show that only part of the damage is repairable, and the recuperation efficiency is the same for all strains, and therefore is not correlated with radioresistance. The absolute amount that a cell can repair, as estimated by the size of the conditioning dose is strictly proportional to the shoulder width and independent of the extrapolation number and the sensitivity. The time required to reach maximum recovery is strain dependent: 15 min to 1 hr in diploids, 4 hr in tetraploids. Author (NSA)

N66-33916# California Univ., Berkeley. Lawrence Radiation Lab.

RECOVERY OF YEAST AFTER EXPOSURE TO DENSELY IONIZING RADIATION

J. T. Lyman and R. H. Haynes Sep. 1965 21 p refs Presented at the Work Shop Conf. on Space Radiation Biol., Berkeley, Calif., 7–10 Sep. 1965
(Contract W-7405-ENG-48)
(UCRL-16545; CONF-650924-7) CFSTI: HC $2.00/MF $0.50

A great enhancement of viability was observed if nonnutritive suspensions of diploid yeast, which were irradiated with X-rays or heavy ions (^{4}He, ^{12}C, ^{20}Ne), were stored at 30°C in the dark for 4 or more hours prior to plating. Maximum recovery was usually observed after 24 to 48 hours; the survival curves obtained upon delayed plating were related to those for immediate plating by a constant dose-modifying factor. Several lines of evidence indicate that recovery is based upon enzymic postirradiation processes unrelated to the initial physiochemical reactions associated with absorption of the radiation. The recovery appears to be substantially independent of the precise chemical nature of the radioinduced lesions. Very severe macromolecular damage is likely to be produced by the densely ionizing radiations. The ability of diploid yeast to recover after such irradiation suggests that a bypass rather than a direct repair mechanism may be involved. Author (NSA)

N66-33917# Medical Research Council, London (England).

A SEARCH FOR THE GENETIC EFFECTS OF HIGH NATURAL RADIOACTIVITY IN SOUTH INDIA

H. Grueneberg, G. S. Bains, R. J. Berry, Linda Riles, C. A. B. Smith et al London, HMSO, 1966 63 p refs /ts Spec. Rept. Ser. No. 307
HMSO: 11s

The coastal area between Neendakara and Kayankulam, north of Quilon in Kerala, South India, (which is effectively an island) has high natural radioactivity owing to the presence of monazite sand, which contains thorium. The mean gamma radiation on the strip is about seven-and-a-half times that of the control areas inland. The strip has been inhabited and geographically isolated for a very long period. A search for genetic damage was made in rats (*Rattus rattus* L) inhabiting this area. The material examined included the macerated skeletons and teeth of 438 rats from eight localities on the strip and of 458 rats from eight control localities inland. In addition, data were collected from these animals on fertility and embryonic mortality. No evidence was found that variance was greater in the irradiated than in the control populations. Possible explanations are discussed. NSA

N66-33924# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.

EVOLUTION OF GLYCEMIA IN THE RAT AFTER GAMMA IRRADIATION [EVOLUTION DE LA GLYCEMIE CHEZ LE RAT APRES IRRADIATION GAMMA]

Georges Marble, Henri Frossard, Lucien Breuil, and Robert Engler Dec. 1965 11 p refs In FRENCH
(CEA-R-2922)

The study of glycemia variations in the rat after irradiation has made it possible to observe not only a premature hyperglycemia but also a belated hypoglycemia whose importance and subsequent evolution seem to depend on the dose given to the animal. Author (NSA)

N66-33948# Commissariat a l'Energie Atomique, Grenoble (France).

STUDY OF THE FIBRINOGEN–FIBRIN TRANSFORMATION KINETICS AND MODIFICATIONS CAUSED TO THIS REACTION BY IRRADIATION (X-RAYS) OF THE FIBRINOGEN SOLUTION [ETUDE DE LA CINETIQUE DE LA TRANSFORMATION FIBRINOGENE–FIBRIN ET MODIFICATIONS APPORTEES DANS CETTE REACTION PAR IRRADIATION (RAYONS X) DE SOLUTION DE FIBRINOGENE]

Daniel Hollard, Michel Suscillon, Genevieve Marcille, Francoise Rambaud, and Marie Baloyan Feb. 1966 10 p refs
(CEA-R-2949)

A spectrophotometric method is presented for studying the transformation of fibrinogen into fibrin. This method has the advantage of presenting immediately in graph form the three phases of this transformation, namely proteolyse or

monomerisation, polymerisation, and clot stabilization. Modifications of this transformation due to x-irradiation of fibrinogen solution were studied. Low doses (90,000 R/mm) prevented transverse polymerisation and doses of 180,000 R and more affected the action of thrombin on fibrinogen and did not given an organised clot, but a fragile gel. Author (NSA)

N66-33985# Joint Publications Research Service, Washington, D. C.

PHYSIOLOGICAL METHODS IN COSMONAUTICS

R. M. Bayevskiy 18 Aug. 1966 321 p refs Transl. into ENGLISH of the book "Fiziologicheskiye Metody v Kosmonavtike" Moscow, 1965 p 1-300

(JPRS-37096; TT-66-33525) CFSTI: $7.00

A monograph covering a broad sphere of problems related to the field of obtaining medical-biological information from space flights is presented. A brief historical review of physiological studies in outer space conducted with balloons, aircraft, rockets, artificial earth satellites, and spacecraft is given. The methods and means of space physiology as applicable to a flight experiment, and general aspects of physiological measurements during space flights through the use of physiological measuring-information systems are discussed. Individual physiological techniques (electrocardiography, phonocardiography, seismocardiography, kinetocardiography, arterial oscillography and sphygmography, actography, electromyography, electroencephalography, and other methods) used during flight experiments with animals and cosmonauts are also discussed. In addition, a bibliography of material relating to the subject area is given. L.S.

N66-34013# Brussels Univ. (Belgium).

NEUROPHYSIOLOGIC CORRELATES OF SENSORY PERCEPTION Final Scientific Report, Feb. 1, 1966-Jan. 31, 1966

John E. Desmedt 15 Mar. 1966 14 p refs

(Grant AF-EOAR-65-57)

(AFOSR-66-0929; AD-633967) CFSTI: HC $1.00/MF $0.50

The functional capabilities and mode of operation of several parts of the feedback neural circuits related to acoustic sensory processing were further investigated in several animal species. The neurochemical properties of the efferent cochlear system of the bird have been defined, showing that strychnine and brucine block the efferent neural influence on the inner ear though with modalities different from those in mammals. The efferent inhibition behaves pharmacologically as a postsynaptic inhibition. In monkeys, the organization of corticofugal projections from the temporal areas of the cerebral cortex were investigated in detail with the nauta and other techniques. In related studies, psychophysiological methods were developed to assess the capabilities of monkeys namely in their dealing with complex acoustic stimuli. In the cat, the studies on acoustic system were mainly concerned with the correlation of physiological evidence related to centrifugal pathways of the auditory system with the anatomical studies performed with nauta technique. Another series of experiments were made on human subjects in order to demonstrate objective changes in cerebral electrogenesis related to the performance of decision tasks. Clear-cut modifications of components of the sensory evoked potentials averaged by digital computers were described and used in the analysis of the cerebral mechanisms underlying signal detection. A series of experiments were initiated on the kinetics of transmitter metabolism in nerve endings in human subjects. These experiments are to be continued with the aim of contributing to optimization of long-term motor performance in man under stressful conditions. Author (TAB)

N66-34072*# Northrop Space Labs., Hawthorne, Calif.

INVESTIGATION OF PEROGNATHUS AS AN EXPERIMENTAL ORGANISM FOR RESEARCH IN SPACE BIOLOGY Progress Report, 1 Apr.-30 Jun. 1966

R. C. Lindberg [1966] 18 p refs

(Contract NASw-812)

(NASA-CR-77100; NSL-64-29-11) CFSTI: HC $1.00/MF $0.50 CSCL 06F

The anatomical structures of the brain of the species Perognathus longimembris were identified. The study was undertaken to provide orientation in the internal structures of the brain and to establish the feasibility of using the species for investigating the neurological basis of entry into and arousal from hibernation. It is concluded that the small size of the animal and its brain dictate the need for the development of special handling techniques and equipment if the species is to be used for neurophysiological research. Pictures of cross sections are included. D.T.

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N66-32800*# Ling-Temco-Vought, Inc., Dallas, Tex. Astronautics Div.

REMOTE MAN-MACHINE CONTROL SYSTEM EVALUATION Final Report

A. G. Charron Aug. 1964 230 p refs *Its* Rept.-00.424

(Contract NASw-744)

(NASA-CR-76889) CFSTI: HC $3.75/MF $1.25 CSCL 05H

Remote control systems for space exploration and the various configurations of such systems are given. An operations analysis on a representative mission was performed, and a system requirements methodology was developed. Studied was the detailed reconnaissance of the Martian surface and its environment. The general environmental parameters were determined and related to the information requirements to fix the location of sensors for data acquisition. Automatic and remotely controlled system approaches were compared with respect to reliability, weight, and cost. The location of man and his role in the loop was compared, with man being considered in the role of an information manager, and a man/machine loop analysis summary format was developed as a means of defining system requirements. The mission description is for a typical remotely controlled system in a representative manned capture orbit profile. Studies of eccentric, circular, and synchronous Martian orbits and multiple surface sites were made and the implications of the various orbits compared. Examples for the tasks of observation and locomotion are presented in tables. K.W.

N66-32959*# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

CHARACTERIZATION OF TIME-VARYING HUMAN OPERATOR DYNAMICS

G. A. Gagne and W. W. Wierwille, Washington, NASA, Aug. 1966 87 p refs

(Contract NAS1-4920; Proj. ICARUS)

(NASA-CR-539) CFSTI: HC $3.00/MF $0.75 CSCL 05H

Linear time-varying, nonlinear time-varying, and nonlinear constant coefficient models of the human operator in tracking tasks were determined. The experiments were to characterize the human operator. The deterministic time varying characterization theory was used, and a set of rules by which each

operator responds to the displayed signals was devised. The determination of the causes of the time-variations in the transfer characteristics was emphasized. Three experienced pilot–engineers and one non-pilot engineer were the subjects. Linear time-varying models were obtained for tracking tasks with various one- and two-axis displays with corresponding one- and two-axis dynamics. Follow-up dynamics were the same for all experiments and were identical for both axes. They were chosen so as to be similar to the pitch and roll dynamics of a jet fighter aircraft. An attempt was made to develop a "logic model" of the operators, which was to simulate their logic strategy while tracking in a control system. Instrument arrangements and data processing methods are included. The studies indicate that logic models with accuracies of 15% to 20% N.I.S.E. are theoretically possible. K.W.

N66-32963*# Sandia Corp., Albuquerque, N. Mex. Planetary Quarantine Dept.

AN ASSEMBLY CONTAMINATION MODEL

E. J. Sherry and C. A. Trauth, Jr. Jul. 1966 36 p refs

(NASA Order R-09-019-040)

(NASA-CR-76999; SC-RR-66-421) CFSTI: HC $2.00/MF $0.50 CSCL 08T

A model of biological contamination of a structure during assembly is developed. This model is stochastic in nature, treating both the amount of contamination and its surface distribution on the structure as random variables. It is hoped that by using this model and subsequent refinements of it, one may be able to specify conditions under which the level of biological contamination of a structure may be predicted statistically with any desired degree of confidence. Author

N66-33042# Flying Personnel Research Committee, London (England).

VENTILATION UNDER A COMBINED PARTIAL PRESSURE ASSEMBLY: A COMPARISON OF TWO AIR VENTILATED SUITS IN MAINTAINING THERMAL BALANCE BY EVAPORATION OF SWEAT

J. M. Clifford and R. H. Farrow Oct. 1965 14 p refs

(FPRC/MEMO-221) CFSTI: HC $1.00/MF $0.50

The air ventilated suit Mk 2 was shown on two counts, the final pulse rate and final oral temperature, to be a better air ventilated suit than the Mk 3 under the experimental conditions. It is also suggestive that the insulation provided by the ventile immersion suit is beneficial when the AVS is receiving the specified air ventilated suit air supplies under these experimental conditions. Author

N66-33044# Flying Personnel Research Committee, London (England).

THE USE OF THE PRESSURE ECONOMISER OXYGEN SYSTEM IN HIGH PERFORMANCE AIRCRAFT IN WHICH CREW MEMBERS ARE ROUTINELY EXPOSED TO POSITIVE ACCELERATIONS

J. Ernsting Sep. 1964 15 p refs

(FPRC/MEMO-215) CFSTI: HC $1.00/MF $0.50

The prevention of the lung collapse which is induced by exposure to positive acceleration whilst breathing 100% oxygen is discussed. It is concluded that the inspired gas should contain at least 50% nitrogen in order to reduce the incidence of lung collapse in flight to an acceptable level. The concentration of nitrogen provided by pressure economiser breathing systems has been considered in relation to pulmonary ventilation and altitude. It is concluded that, at its best, the pressure economiser system which is acceptable for use in high performance aircraft will provide much less than 50% nitrogen in the inspired gas during quiet breathing at altitudes greater than 10,000 ft. In view of the evidence at present available, it is recommended that pressure economiser systems are unacceptable for use in all aircraft where the crew may be routinely exposed to positive accelerations. Author

N66-33138# Royal Swedish Academy of Sciences, Stockholm.

VIBRATIONS OF TRACTOR DRIVER

Sigfrid Bjerninger 1966 127 p refs *Its* Acta Polytechnica Scandinavica Mech. Eng. Ser. No. 23

CFSTI: HC $4.00/MF $1.00

The vibrations to which the tractor driver is exposed were field tested using different tractorseat designs, suspension and damping characteristics, tractors, ground and road conditions, and varying speeds. Laboratory experiments included testing the spring characteristics and the suspension dynamics of different seats, and also the possibilities of decreasing the vibration strains on the driver by choosing suitable seat suspension and damping. Seat design in other respects and the positioning of the seat were also studied. The results from theoretical investigations were compared with those from the laboratory experiments and field tests. It was evident that the suitability of the seat with regard to suspension and damping characteristics can be determined quite satisfactorily by determining the static spring characteristics and by drop tests. The correct combination of tractor and seat with driver can be tested by placing the tractor on a vibration machine with only the rear wheels on the uneven rollers. The investigation indicated the technical possibilities of decreasing the vibration strains to which tractor drivers are exposed, and principles for the design and choice of tractor seats were established. Author

N66-33198*# General Dynamics/Convair, San Diego, Calif.

FEASIBILITY STUDY OF FREEZE-OUT TECHNIQUES FOR CONTAMINANT CONTROL WITHIN MANNED SPACECRAFT ATMOSPHERES Final Technical Report, 11 Oct. 1965–11 Apr. 1966

G. L. Drake, E. J. Russ, J. C. Ballinger, W. J. Sevier, and D. W. Vorbeck 27 May 1966 151 p refs *Its* Rept.-64-26243

(Contract NAS1-5625)

(NASA-CR-66150) CFSTI: HC $5.00/MF $1.00 CSCL 05E

An analytical and experimental program in three phases was carried out for the purpose of assessing the feasibility of a freeze-out technique for control of trace contaminants in atmospheres of manned spacecraft. The Phase I task area was to perform analysis which defined performance and limitations of the techniques, based on the MORL vehicle in the primary and several alternate missions. The Phase II experimental effort included design, fabrication, and operation of a laboratory breadboard freez-out apparatus to determine freeze-out performance with a selected group of potential contaminants. The Phase III task area was to evaluate feasibility of the method, based on results of Phases I and II, and to establish follow-on objectives. Author

N66-33248# Mitre Corp., Bedford, Mass.

STUDIES OF DISPLAY SYMBOL LEGIBILITY. PART IX: THE EFFECTS OF RESOLUTION, SIZE, AND VIEWING ANGLE OF LEGIBILITY

Donald Shurtleff, Marion Marsetta, and Diane Showman May 1966 47 p refs

(Contract AF 19(628)-5165)

(MTR-5; ESD-TR-65-411; AD-633833) CFSTI: HC $2.00/MF $0.50

An investigation was made to determine the visual sizes required for the identification of standard and revised Leroy

alphanumerics, which were televised at resolutions of 10, 8 and 6 lines per symbol height. The visual size needed for 99% identification accuracy was similar for resolutions of 10 and 8 lines, but a significantly larger visual size was required for symbols resolved by 6 lines. There were no significant differences in visual sizes required for identification of standard versus revised Leroy symbols at any value of resolution. The findings were used to calculate the effective area for viewing televised symbols. Author (TAB)

N66-33259# Systems Development Corp., Santa Monica, Calif.
AN EMPIRICAL COMPARISON OF ON-LINE AND OFF-LINE DEBUGGING
E. E. Grant 18 May 1966 19 p refs
(Contract AF 19(628)-5166; ARPA Order-773)
(SP-2441; AD-633907) CFSTI: HC $1.00/MF $0.50

The experiment compared the program debugging (check-out) performance of programmers using a time-sharing system (TSS) with the debugging performance of programmers using a simulated closed shop. Twelve programmers participated in the study. Each programmer was given two problem statements and was asked to write a program to solve each. One problem required a program to interpret and solve algebraic equations, the other problem required a program to find the single path through a 20×20 cell maze represented in the computer by a 400-entry table. Six solutions (programs) to each problem were debugged on line using TSS and six were debugged off line using a simulated closed-shop system with a desk-to-desk turnaround time of two hours. Performance was measured in terms of man hours to debug and central processor time used in debugging. Programmers who debugged their algebraic interpretation programs on line used slightly fewer man hours and about three times as much central processor time as did programmers who debugged these programs off line. Programmers who debugged their maze programs on line used about one-third as many man hours and slightly more central processor time than those who debugged their maze programs off line. TAB

N66-33265# Mitre Corp., Bedford, Mass.
STUDIES OF DISPLAY SYMBOL LEGIBILITY. PART IV: THE EFFECTS OF BRIGHTNESS, LETTER SPACING, SYMBOL BACKGROUND RELATION AND SURROUND BRIGHTNESS ON THE LEGIBILITY OF CAPITAL LETTERS
Donald Shurtleff, Beverly Botha, and Marion Young May 1966 25 p refs
(Contract AF 19(628)-5165)
(W-06899; ESD-TR-65-134; AD-633853) CFSTI: HC $1.00/MF $0.50

Two exploratory studies are reported in which the effects of brightness, letter spacing, symbol background relation, and surround brightness on legibility were determined. As a measure of legibility, both studies used the reciprocal of the visual angle subtended at the eye by capital letters when the subject identified correctly 50 percent of the letters in a matrix. A matrix consisted of 20 letters arranged in 4 rows and 5 columns. The first study showed that legibility was significantly altered by brightness, spacing, and symbol background relations. The complexity of the effects of each of these factors was shown by the significant interactions among them. The second study showed surround brightness for the light letters on a dark background to be significant factor in legibility. Author

N66-33363# Mitre Corp., Bedford, Mass.
STUDIES OF DISPLAY SYMBOL LEGIBILITY. PART VI: LEROY AND COURTNEY SYMBOLS
Donald Shurtleff and D. Owen May 1966 39 p refs
(Contract AF 19(628)-5165)
(ESD-TR-65-136; TM-4212; AD-633856) CFSTI: HC $2.00/MF $0.50

At vertical resolutions of 12-, 10-, 8-, and 6-scan lines per symbol height, the legibility of Courtney alphanumeric symbols, designed especially for television, was compared with that of standard Leroy symbols. These symbols were presented singly on a 525-line TV monitor, and the speed and accuracy with which they were identified by groups of subjects having normal vision were recorded. A group of subjects viewed only the Courtney symbols, while another viewed only the Leroy. The results showed that, at any resolution value, identification of Courtney symbols was no better than for Leroy. Some practice was required with the Courtney symbols before it was possible to obtain a performance equal to that of the Leroy. This study supports the findings of other experiments: that a resolution of 10 lines per symbol height remains the lowest value recommended for TV displays. Author (TAB)

N66-33387*# California Univ., Los Angeles.
SPECTRAL ANALYSIS TECHNIQUES AND PATTERN RECOGNITION METHODS FOR ELECTROENCEPHALOGRAPHIC DATA
W. R. Adey [1966] 42 p refs
(Grant NsG-502)
(NASA-CR-77039) CFSTI: HC $2.00/MF $0.50 CSCL 06B

Computing systems currently in use at the Brain Research Institute and computational methods and associated display techniques are discussed in terms of their application to electroencephalographic records for animals and man; and for the latter, in relation to baseline characteristics of a population of individuals in a gamut of states in sleep and wakefulness. Simple automated pattern recognition techniques applied to such records are described, as are computer applications to impedance measurements and cellular wave phenomena and the formulation of physiological models. Application of spectral analysis to a normative library of EEG data in states of sleep and wakefulness is described and illustrated, with establishment of baselines for adult males in the course of simple alerting vigilance task performance, and in visual discrimination of increasing difficulty. Possible future trends in electrophysiological data analysis are reviewed. M.W.R.

N66-33426# Computer Concepts, Inc., Los Angeles, Calif.
THE ROLE OF COMPUTERS IN HANDLING AEROSPACE SYSTEMS HUMAN FACTORS TASK DATA Final Report, 3 Jun. 1964-3 Jun. 1965
Irvin R. Whiteman Wright-Patterson AFB, Ohio. AMRL Dec. 1965 183 p refs
(Contract AF 33(615)-1557)
(AMRL-TR-65-206; AD-631182) CFSTI: HC $5.00/MF $1.00

The characteristics of a computer based data system for handling human factors task information generated in support of advanced system development are described. On the basis of information gathered from users and generators of data at representative Government and contractor installations, the current and potential uses of computers were assessed to determine the desirable characteristics for a computerized human factors task data handling system. The proposed data handling system will assist the human factors specialist and system design engineers in the design and development of systems by providing them with means for: (1) drawing them closer to the data through a user-oriented system, (2) comparing data generated throughout the life-cycle of an advanced system and across systems, (3) analyzing data and conducting man-machine simulations, and (4) insuring that data are made

available on a selective query and a timely basis. These objectives are met within the framework of a data system concept referred to as CENTRAL. The functions of CENTRAL are: (1) data storage and retrieval, (2) data processing, (3) computer program maintenance, and (4) system operational manual maintenance. Author (TAB)

N66-33481*# Systems Technology, Inc., Hawthorne, Calif.
PILOT DESCRIBING FUNCTION MEASUREMENTS IN A MULTILOOP TASK
R. L. Stapleford, D. T. Mc Ruer, and R. Magdaleno Washington, NASA, Aug. 1966 36 p refs
(Contract NAS2-1868-3)
(NASA-CR-542) CFSTI: HC $2.00/MF $0.50 CSCL 05H

Data essential for the development of detailed adjustment rules, loop closure criteria, and other aspects of model refinement are presented for multiloop systems. It is shown that the number of measurable pilot describing functions is equal to the number of uncorrelated inputs times the number of pilot outputs or controls. The aircraft control situation selected, consisting of a bank angle tracking task, is described. The following conclusions were drawn: (1) For multiloop control systems with an integrated display, the quasilinear pilot model and adjustment rules evolved for single loop systems are applicable to the multiloop system command loop. (2) The single loop pilot model is also applicable, with reservations, to inner loop closures. (3) When it is advantageous, a pilot can adopt a control crossfeed to reduce the inadvertent excitations of a subsidiary or nuisance mode. (4) Pilot performance in the command loop can be as good as that in a single loop task; however, his subjective opinion will be severely degraded. (5) When several feedback possibilities are present in a multiloop situation, the pilot will select those permitting the best dynamic performance with least pilot effort. L.E.W.

N66-33484# Hofstra Coll., Hempstead, N. Y.
PRACTICE EFFECTS, KNOWLEDGE OF RESULTS AND TRANSFER IN PITCH DISCRIMINATION
Walter I. Heimer and Sherman J. Tatz (C. W. Post Coll.) Port Washington, N. Y., Naval Training Device Center, Apr. 1966 31 p refs
(Contract N61339-1337)
(NAVTRADEVCEN-IH-52; AD-634221) CFSTI: HC $2.00/MF $0.50

The effect of practice on the ability of Ss to discriminate differences in pitch between two sounds (difference thresholds or DLs) was investigated using four different experimental groups. These four groups differed in regard to the frequency at which training was given (800 or 3,000 cps), and whether or not knowledge of results was given. All discriminations were made against a white noise background. Training was given to all experimental Ss for four successive days with a fifth day devoted to both practice and a transfer test. The daily procedure consisted of listening to three tapes, each requiring 100 discriminations. A modified descending staircase procedure (method of limits) was utilized in obtaining the difference thresholds. The main findings were: (1) a negatively accelerated, declining curve of DLs for all four experimental groups with the largest drop taking place within the first day or two for most Ss, (2) discrimination was slightly better with knowledge of results than without, but not significantly so, and (3) the surprising fact that a net negative transfer of training effect was revealed when the transfer was attempted between the two different points on the frequency spectrum utilized here. Implications for auditory training procedures are discussed. Author (TAB)

N66-33594# Educational Testing Service, Princeton, N. J.
COEFFICIENT ALPHA AND THE RELIABILITY OF COMPOSITE MEASUREMENTS Technical Report No. 1
Melvin R. Novick and Charles Lewis Apr. 1966 28 p refs
(Contract Nonr-4866(00))
(RB-66-18; AD-633840) CFSTI: HC $2.00/MF $0.50

Following a general approach due to Guttman, coefficient α is derived as lower bound on the reliability of a test. The necessary and sufficient condition under which equality is attained in this inequality and hence that α is equal to the reliability of the test is derived and shown to be closely related to the recent redefinition of the concept of parallel measurements due to Novick. This condition is then also shown to be closely related to the unit rank assumption originally adopted by Kuder and Richardson in the derivation of their formula 20. The assumption later adopted by Jackson and Ferguson and the one adopted by Gulliksen are shown to be related to the necessary and sufficient condition derived here. It is then pointed out that the statement that "coefficient α is equal to the mean of the split-half reliabilities" is true only under the condition assumed by Cronbach in the body of his derivation of this result. Finally some limitations on the uses of any function of α as a measure of internal consistency are noted.
Author (TAB)

N66-33612# George Washington Univ., Washington, D. C. Human Resources Research Office.
SUMMARY OF LITERATURE REVIEW ON EXTENDED OPERATIONS Consulting Report
Dennis Cannon, Eugene Drucker, and Theodore Kessler Dec. 1964 58 p refs
(Contract DA-44-188-ARO-2)
(AD-634037) CFSTI: HC $3.00/MF $0.75

The report comprises a summary of a review of psychological literature pertaining to performance for extended periods of time. The material is organized into the following topics, as they relate to performance: sleep loss, temperature, nutrition, prolonged performance, drugs, stress, vibration, confinement, rest and personnel replacements, noise radiation, and clothing. In addition, a brief summary of vigilance literature is included. The inconclusive nature of the reviewed research precludes supporting or denying the thesis that troops can be expected to remain effective for 48 hours or longer. Endurance limits may vary significantly from one task to another. For this reason, suggestions for research are included.
Author (TAB)

N66-33640# Research Analysis Corp., McLean, Va.
EVALUATION OF MULTIPLE-CRITERIA ALTERNATIVES USING ADDITIVE UTILITY MEASURES
Peter C. Fishburn Mar. 1966 35 p refs
(Contract DA-44-188-ARO-1)
(RAC-TP-200; AD-633595) CFSTI: HC $2.00/MF $0.50

This paper explains two theories behind additive methods of using human value judgments in the evaluation of multifactor alternatives and describes how these methods may be used. The alternatives to be evaluated in such situations may be, for example, people, performances, plans, policies, products, or systems. The two additivity theories presented come from utility theory, which is concerned with people's preferences. One of these theories is nonprobabilistic; the other uses probabilities. Among the methods discussed for obtaining an evaluator's utility functions for the criteria in a multifactor or multiple-criteria situation are a number of indifference-judgment methods, a method that uses probabilities (the gambles method), and a class of direct numerical-assignment methods. Author (TAB)

N66-33641# Air Force Systems Command, Wright-Patterson AFB, Ohio. Systems Engineering Group.
EVALUATION OF IMPROVED EXHALATION VALVE FOR HGU-8/P FLYING HELMET Final Report, Aug. 1963–Dec. 1965
Donald R. Good Apr. 1966 33 p
(SEG-TR-66-7; AD-633952) CFSTI: HC $2.00/MF $0.50

This report records the results of a component improvement program on an exhalation valve for the HGU-8/P partial pressure suit helmet. The program was intended primarily to eliminate the tendency for sudden pressure loss within the helmet caused by improper and erratic closing characteristics of the exhalation valve and to meet additional design objectives of greater opening sensitivity, lower pressure drops during flow conditions, and an overall increase in reliability. The valve and its function are described. Internal friction of moving parts was reduced. The opening or cracking pressure was reduced and the differential pressure under flow conditions was improved significantly. Test procedures and results obtained during low temperature tests and room temperature tests at high altitude are presented. It is concluded that the improved design meets the initial objectives of the program.
Author (TAB)

N66-33682# School of Aerospace Medicine, Brooks AFB, Tex.
AN EMERGENCY DENTAL KIT ENCASEMENT FOR USE ON EXTRATERRESTRIAL MISSIONS Progress Report, 24–27 Jan. 1966
Jack H. Ferguson and Jack L. Hartley Apr. 1966 13 p
(SAM-TR-66-34; AD-634466) CFSTI: HC $1.00/MF $0.50

Steps were taken to construct an emergency dental kit for buddy or self-care during prolonged space flight. Initial steps taken included a material study, material selection, a design study, prototype design, and destructive testing of a model. Also included is an explanation of the properties of Lexan and Nopcofoam, the materials selected, as well as of the other materials considered. A design based on sandwich construction was developed and the characteristics of this design are summarized.
Author (TAB)

N66-33730# Naval Air Development Center, Johnsville, Pa. Aerospace Medical Research Dept.
THERMAL PROTECTION PRINCIPLES
Alice M. Stoll and Maria A. Chianta *In* AGARD Collected Papers Presented at the 22d Meeting of the AGARD Aerospace Med. Panel Sep. 1965 p 33–48 refs (See N66-33726 19-04) CFSTI: HC $5.93/MF $2.75

This study concerned protection against intense thermal exposures which produce burns as opposed to protection against heat loss or gain due to long term environmental heat exchange. It is stated that the basic thermal protection principle is the prevention of the establishment, for significant periods of time, of tissue temperatures above 44°C. In convective heating, the heat transfer mode must be limited to that of low temperature radiation by air spaces between the insulating material and the skin. Further protection may be afforded by a second layer of resistant material. In conduction heating, heat transfer can only be reduced by a suitable thickness of appropriate material. In high intensity radiation, the most effective measures depend upon control of the optical properties of the exposed material so that transmittance is eliminated, and transfer of absorbed energy is confined to modes of conduction and low temperature radiation. It is additionally emphasized that the characteristics of the hazard must be considered in thermal protection investigations.
H.S.W.

N66-33731# Centre d'Essais en Vol, Bretigny-sur-Orge (France). Laboratoire de Medecine Aerospatiale.
EXPERIMENTAL STUDY OF THE COEFFICIENTS FOR HEAT EXCHANGE BY CONVECTION [COEFFICIENTS D'ECHANGE DE CHALEUR PAR CONVECTION ETUDE EXPERIMENTALE]
J. Colin and Y. Houdas *In* AGARD Collected Papers Presented at the 22d Meeting of the AGARD Aerospace Med. Panel Sep. 1965 p 49–72 refs In FRENCH; ENGLISH Summary (See N66-33726 19-04) CFSTI: HC $5.93/MF $2.75

Aerodynamic heating of supersonic aircraft has reversed the problem of creating habitable temperatures in the cockpit. For a long time, the objective was to heat the cabin; nowadays, it must be cooled—the more drastically, the greater the speed of the aircraft. In calculating the required heating/cooling, the different ways of the human body's heat exchange to avoid overheating is considered. As is well known, this exchange takes place in four principal ways: conduction, convection, radiation, and evaporation. Some of these are well documented; others have been subjected to only limited experimentation. Among the latter, the literature on convection is relatively scanty; in addition, great divergences exist among the coefficients formulated by different researchers. The authors describe their experimental approach to this problem, and the determination of a coefficient based on the data obtained.
Author

N66-33732# Royal Air Force, Farnborough (England). Inst. of Aviation Medicine.
SOME ASPECTS OF PERSONAL COOLING IN INADEQUATELY AIR CONDITIONED COCKPITS
J. M. Clifford *In* AGARD Collected Papers Presented at the 22d Meeting of the AGARD Aerospace Med. Panel Sep. 1965 p 73–86 (See N66-33726 19-04) CFSTI: HC $5.93/MF $2.75

Data are presented from tests conducted using an air ventilated flying suit, and a water cooled flying suit, in research to find a means for maintaining a comfortable body temperature for aircrew members. The tests showed that each suit provided adequate personal comfort, however when wearing the water cooled suit a dangerous situation may occur if the cooling system fails during flight. It is stated that a personal cooling system using both air and water should prove to be the most advantageous.
H.S.W.

N66-33733# Entwicklunging Sud, Munich (West Germany).
PSYCHOPHYSIOLOGICAL AND HUMAN ENGINEERING CONSIDERATIONS IN THE INSTRUMENTATION AND CONTROL OF VTOL AIRCRAFT
H. von Diringshofen and W. Burkhardt *In* AGARD Collected Papers Presented at the 22d Meeting of the AGARD Aerospace Med. Panel Sep. 1965 p 87–93 (See N66-33726 19-04) CFSTI: HC $5.93/MF $2.75

The psychophysical impact on pilots of the tendency in modern aviation technology towards automatic aircraft controls, particularly in VTOL aircraft, is assessed. This problem is discussed in terms of the following psychological and human engineering problems: (1) A rejection of increasing automation on the part of the pilots, (2) A reluctance of some aircraft designers with regard to the complex automatic controls whose reliability has not always been sufficiently proved, (3) The problem of training pilots to quickly intervene when automatic systems fail. The consequences of these problems in the field of aviation medicine are briefly discussed.
H.S.W.

N66-33738# Office National d'Etudes et de Recherches Aeronautiques, Paris (France). Centre Principal d'Expertise Medicale du Personnel Navigant de l'Aeronautique.
USES OF ELECTRORETINOGRAPHY IN THE DETERMINATION OF THE NIGHT VISION CAPACITY OF AVIATORS [INTERET DE L'ELECTRORETINOGRAPHIE DANS L'APPRECIATION DE LA CAPACITE VISUELLE NOCTURNE DES NAVIGANTS]

A. Mercier, G. Perdriel, and J. Chevaleraud *In* AGARD Collected Papers Presented at the 22d Meeting of the AGARD Aerospace Med. Panel Sep. 1965 p 119–123 refs In FRENCH; ENGLISH summary (See N66-33726 19-04) CFSTI: HC $5.93/MF $2.75

Night vision capacity of aviators can be determined by establishing gross and morphoscopic light thresholds and mesopic or scotopic campimetry. These techniques require the cooperation of the subject, since the validity of the examination results depends upon the accuracy of the subject's answers. The electroretinographic examination is an objective procedure which demonstrates the action of the "62" (scotopic) wave. It is of diagnostic, prognostic and therapeutic value in cases of possible hemeralopia in an aviator. Author

N66-33740# Royal Air Force, Farnborough (England). Inst. of Aviation Medicine.

COMPLEX REACTION TIMES AT A SIMULATED CABIN ALTITUDE OF 8,000 FEET

F. Ledwith and D. M. Denison *In* AGARD Collected Papers Presented at the 22d Meeting of the AGARD Aerospace Med. Panel Sep. 1965 p 179–197 refs (See N66-33726 19-04) CFSTI: HC $5.93/MF $2.75

Tests were conducted to confirm the experimental evidence suggested that pilot performance deterioration is detectable while breathing air at a pressure equivalent to an altitude of 8,000 ft, and while breathing in an environment equivalent to air breathing at ground level. Details are given on the form of the experiment, the decompression chamber, the production and monitoring of the gas environment, and argometer used, the apparatus for presentation of the task, and the instructions to the subjects. The results of the tests are given and it is reported that the ability to learn a task, involving spatial transformations of the stimulus materials, appears to be impaired by exposure to a cabin altitude of 8,000 ft. H.S.W.

N66-33743# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio. Office of Director for Research and Development.

ENGINEERED ATMOSPHERES FOR FUTURE AEROSPACE OPERATIONS

A. G. Swan *In* AGARD Collected Papers Presented at the 22d Meeting of the AGARD Aerospace Med. Panel Sep. 1965 p 223–232 refs (See N66-33726 19-04) CFSTI: HC $5.93/MF $2.75

The need for close coordination between the environmental physiologist and the spacecraft designer is highlighted in this reivew of research conducted to evaluate candidate atmospheres for spacecraft applications. The discussion includes atmospheric composition and pressure considerations as well as rapid decompression. The candidate atmospheres which would allow the engineer a choice of an atmosphere for anticipated aerospace missions are listed and a summary of the validation studies completed in these atmospheres in included. Tests are also described, in which dogs and monkeys were used, to determine the effects of rapid decompression. The major conclusions from these research efforts are listed. H.S.W.

N66-33748# Bureau of Medicine and Surgery, Washington, D. C.

DESIGN REQUIREMENTS FOR LIFE SUPPORT HELMETS

Roland A. Bosee *In* AGARD Collected Papers presented at the 22d Meeting of the AGARD Aerospace Med. Panel Sep. 1965 p 295–305 refs (See N66-33726 19-04) CFSTI: HC $5.93/MF $2.75

Impact accidents for all categories of Navy aircraft are summarized, and four helmets developed for pilot protection are shown. These are designed for use by attack and fighter pilots, patrol plane pilots, and helicopter crewmen. Development efforts on proposed life support helmets are discussed, in relation to the major research areas. These include (1) test methods for determining helmet displacement relative to the head; (2) impact resistance properties of lightweight materials suitable for shell construction; (3) test methods and apparatus for determining helmet center of mass; (4) head–neck dynamics under severe deceleration forces; and (5) helmet sizing or fit, and its influence on comfort. M.G.J.

N66-33749# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.

THE EFFECTS OF VIBRATION ON HUMAN PERFORMANCE

C. Stanley Harris and Richard W. Shoenberger *In* AGARD Collected Papers Presented at the 22d Meeting of the AGARD Aerospace Med. Panel Sep. 1965 p 307–326 refs (See N66-33726 19-04) CFSTI: HC $5.93/MF $2.75

Vibration studies are reviewed, and details are given on experiments conducted to determine the effects of vibration frequency on human performance, to compare the effects of sinusoidal versus random vibration, and to examine the performance effects of vibration as a function of the duration of exposure. The different amplitudes and peak G administered to the subjects in three experiments are listed, and the variances for the vertical tracking scores are analyzed. Results indicate that the increase in horizontal error as a result of vibration was negligible for the G levels used for all three frequencies; the vertical error showed a significant effect due to G levels. Studies directed toward comparing the performance effects of sinusoidal and random vibration resulted in the failure to find a significant effect for vibration conditions. Although it was concluded that sinusoidal and random vibration have the same effect on performance, the experimental restrictions imposed in the study are pointed out. M.G.J.

N66-33750# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.

THE INFRASONIC NOISE ENVIRONMENT IN AEROSPACE OPERATIONS

Elizabeth Guild *In* AGARD Collected Papers Presented at the 22d Meeting of the AGARD Aerospace Med. Panel Sep. 1965 p 327–342 refs (See N66-33726 19-04) CFSTI: HC $5.93/MF $2.75

Data on the effects of low frequency sound on man are reviewed, based on observations made in operational environments and preliminary studies conducted under laboratory conditions. Representative noise spectra generated by turbojet aircraft operating in afterburner during ground maintenance are depicted. Extrapolation of the curve showing the maximum level of infrasound to a distance of about 6000 ft indicate that the surrounding communities receive significant levels of acoustical energy in the range below which the hearing organ responds. Noise spectra measurements during liftoff and early flight of the Saturn SA-1 are assessed. Results of exposures of five noise-experienced military subjects to wideband noise environments point up the importance to subjective sensations of the relative amount of high frequency energy present in the spectrum. Laboratory tests indicate that current and anticipated infrasound levels offer no problem to persons directly exposed in the near field. However, from the long range viewpoint, it is concluded that infrasound may induce direct adverse responses unless positive measures for its control are developed and applied. M.G.J.

N66-33751# Centre d'Essais en Vol, Bretigny-sur-Orge (France). Laboratoire de Medecine Aerospatiale.

MEASUREMENT OF LOW-FREQUENCY VIBRATIONS IN BIG HELICOPTERS AND THEIR TRANSMISSION TO THE PILOT [MESURE DES VIBRATION DE BASSE FREQUENCE SUR HELICOPTERE LOURD ET LEUR TRANSMISSION AU PILOTE]

H. Seris and R. Auffret *In* AGARD Collected Papers Presented at the 22d Meeting of the AGARD Aerospace Med. Panel Sep. 1965 p 343-354 refs In FRENCH; ENGLISH Summary (See N66-33726 19-04) CFSTI: HC $5.93/MF $2.75

Analyses are presented of the vibrations recorded at the seat level and on the sternum and cranium of the pilot. Sources are identified as (1) very low frequency vibrations due to atmospheric turbulence occurring at low altitudes and in clouds; and (2) vibration caused by mechanical factors in the main rotor and the anti-torque rotor. The frequencies transmitted to the cockpit are multiples of the number of blades of the frequency of rotor rotation. The helicopter used produced mechanical vibrations of 20 Hz and above, caused principally by the main rotor. The damping function of the body upon increased frequencies is demonstrated, with the resonant frequencies of the human body found in the 4 to 6 Hz region in seated subjects. Between 25 and 30 Hz, an over-acceleration of the head in relation to the shoulder was observed. Above 6 Hz, a damping effect occurs especially in the longitudinal axis. The problem of damping very low frequencies (2 to 6 Hz) is considered the most difficult to solve; deflections of several units of 10 cm would be necessary to reduce the resonance of the seat-pilot system below these figures. M.G.J.

N66-33752# Naval Air Development Center, Johnsville, Pa. Aerospace Medical Research Dept.

THE DYNAMIC SIMULATION OF TURBULENCE PENETRATION

Lloyd Hitchcock, Jr. and Randall M. Chambers *In* AGARD Collected Papers Presented at the 22d Meeting of the AGARD Aerospace Med. Panel Sep. 1965 p 355-394 refs (See N66-33726 19-04) CFSTI: HC $5.93/MF $2.75

The incidents, accidents, and crashes involving swept wing airline jet transport aircraft during routine flights into atmospheric turbulence are summarized, and the basic problem areas are identified. Details are given on studies aimed at providing flight crews with accurate information, adequate aircraft systems, and appropriate procedures for optimal control during atmospheric turbulence, and in providing pilots with adequate training for safely flying the aircraft under such conditions. The turbulence environment is examined, and possible causes of control error are considered. Two turbulence simulation programs are described. In one, a vertical oscillator with a throw of plus and minus approximately 50 ft simulates the higher frequencies of jostle and buffet accelerations, but is unable to duplicate the lower frequency exposures resulting from flight path variations. In the other, a human centrifuge is used to investigate factors contributing to commercial jet aircraft crashes. Computer mechanization diagrams are included. M.G.J.

N66-33755# Naval Air Development Center, Johnsville, Pa. Aerospace Medical Research Dept.

ACCELERATION TRAINING FOR ASTRONAUTS AND TEST PERSONNEL

Randall M. Chambers and Lloyd Hitchcock, Jr. *In* AGARD Collected Papers Presented at the 22d Meeting of the AGARD Aerospace Med. Panel Sep. 1965 p 429-468 refs (See N66-33726 19-04) CFSTI: HC $5.93/MF $2.75

Concepts and technology relating to centrifuge utilization, with emphasis on the development of dynamic flight simulation techniques, are presented. Details are given on the training programs developed for the Mercury, Gemini, and Apollo astronauts; the Dynasoar (X-20) space pilots; and the aerospace research test pilots. The general acceleration training principles which were derived from these centrifuge simulation and training projects are assessed. These include physiological tolerance, performance tolerance limits, predictions of performance tolerance from physiological tolerance, g-protection, visual decrement, individual differences, acceleration training and practice effects, display characteristics, control devices, feedback sensitivity, task difficulty, higher mental processes, emotional processes, effects of combined stresses, and characteristics of performance decrement and error. Summary data are also presented on the results of experiments involving restraint systems, displays, controls, pressure suit conditions, and acceleration variables. M.G.J.

N66-33756# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.

A MINIATURIZED 7-CHANNEL TELEMETRY SYSTEM FOR MEDICAL RESEARCH

A. R. Marko *In* AGARD Collected Papers Presented at the 22d Meeting of the AGARD Aerospace Med. Panel Sep. 1965 p 469-476 refs (See N66-33726 19-04) CFSTI: HC $5.93/$2.75

Details are given on the development of a 7-channel miniature telemetry system employing pulse duration modulation. In the first models, the following signal conditioners are incorporated: channel 1, high gain differential amplifier for monitoring electroencephalogram; channels 2 and 3, medium gain differential amplifiers for electrocardiograms; channel 4, respiration circuit to be used with mercury strain gauge or thermistor; channel 5, galvanic skin resistance measuring circuit in the 5 to 100 kilo-ohm range; channel 6, amplifier for detecting specific responses in galvanic skin resistance; and channel 7, thermistor circuit to be used for measuring body or skin temperature. Basic limitations of the system are noted. A circuit diagram is included, and it is pointed out that the multiplexer design lends itself to future microminiaturization using already developed microelectronic building blocks. M.G.J.

N66-33757# Royal Air Force, Farnborough (England). Inst. of Aviation Medicine.

MULTISTATION MONITORING DURING RAPID DECOMPRESSION

T. G. Dobie *In* AGARD Collected Papers Presented at the 22d Meeting of the AGARD Aerospace Med. Panel Sep. 1965 p 477-485 (See N66-33726 19-04) CFSTI: HC $5.93/MF $2.75

Physiological monitoring, applied to training aircrew in the use of partial pressure equipment assemblies, is described. The assemblies consist of a partial pressure jerkin, an anti-g suit acting as a pressure garment, and either a pressure demand oxygen mask or a partial pressure helmet depending on the breathing pressures required. The maximum breathing pressures are reached at ground level by a graduated series of training runs. The first run at each new breathing pressure is monitored, with a medical officer alongside the subject. Simultaneously another medical officer is observing the physiological responses on a pen recorder; the recording consists of inspiratory flow, ventilation volume, and lead two ECG. On completing the ground level training, the subject is given a rapid decompression appropriate to his aircrew equipment assembly and aircraft type. The advantages of multistation monitoring are cited, and details are given on a flexible layout involving three decompression chambers, sight and voice communication between the medical officers, and provision for a constant visual cross-reference facility for the officer carrying out the monitoring. M.G.J.

N66-33758# Naval Air Development Center, Johnsville, Pa. Aerospace Medical Research Dept.

VISION RESEARCH FACILITY AT AEROSPACE MEDICAL RESEARCH DEPARTMENT

Gloria T. Chisum, J. B. Lyons, and J. H. Hill *In* AGARD Collected Papers Presented at the 22d Meeting of the AGARD Aerospace Med. Panel Sep. 1965 p 487-498 refs (See N66-33726 19-04) CFSTI: HC $5.93/MF $2.75

Details are given on the vision research facility which consists of automated monocular and binocular optical systems controlled by an automatic digital control and data recording system. The monocular system presents up to four superimposed 60° visual fields to an observer: an ambient light field, a fixation target, a test target, and a background. In the binocular system, each beam contains essentially collimated regions to permit the use of interference filters, focal points at which shuttering and chopping of the light can be accomplished, and an afocal region in which field size and target presentation are effected. The accessory apparatus consists of various instruments which are used to calibrate and monitor stimuli, and to make electrophysiological measurements on experimental observers. To illustrate the integration of the systems, experimental conditions are given for a problem which requires information as to the relative rates of dark adaptation for personnel who have been working in green or red lighted areas. M.G.J.

N66-33759# Naval Air Development Center, Johnsville, Pa. Aerospace Medical Research Dept.

THE CENTRIFUGE METHOD OF DYNAMIC FLIGHT SIMULATION

R. J. Crosbie *In* AGARD Collected Papers Presented at the 22d Meeting of the AGARD Aerospace Med. Panel Sep. 1965 p 499-523 refs (See N66-33726 19-04) CFSTI: HC $5.93/MF $2.75

The evolution of the centrifuge method of dynamic flight simulation is summarized in relation to the modernization program which was undertaken to achieve the desired safety, simplicity, and versatility imposed by new performance requirements and increased use of the facility. Special features of the program are identified as a new centrifuge control center, an interchangeable capsule concept, a larger gondola, a stronger centrifuge arm and gimbal ring, increased slipring capacity, increased number of rotary joints, increased rotational movement of the outer gimbal, new jack panels and wiring to the hub sliprings, new intercommunciation system, third gimbal axis and oscillating platform capsule compatibility, large circuit breakers in the main generator circuit, new lower bearing in main accelerator motor, environmental control console, vacuum caps for the new gondola, and centrifuge building annex. Physical limitations of the centrifuge method, inherent in dynamic flight simulation, are defined. However, notwithstanding these limitations, it is believed that the performance potential of the centrifuge system will satisfactorily meet the requirements of the scheduled and contemplated simulation programs. M.G.J.

N66-33826# Institute for Defense Analyses, Arlington, Va. Research and Engineering Support Div.

STRESS

Joseph Weitz Apr. 1966 43 p refs

(Contract ARPA SD-50)

(IDA/HQ-66-4672; P-251; AD-633566) CFSTI: HC $2.00/MF $0.50

A brief section describes some areas of possible military interest in studies of stress-selection, classification, training, human factors and systems research and, of course, stress as related to the combat situation, among others. Since there is difficulty in accurately defining stress, it was considered most useful to describe stimulus situations which may lead to what is called stress and responses which may occur as a result of the 'stress' situation. The stimuli considered are speeded information processing, overloading, environmental factors, perceived threat, physiological stimulation, isolation, confinement, blocking and frustration, and finally group pressures. The responses discussed are performance decrement, immobilization, inappropriate responses, physiological changes, verbal report, and performance enhancement, considering the stimulus situations which lead to stress and the responses which may be evoked as a result of certain stimulus situations. An attempt is made to suggest research areas which may prove useful in better understanding the stress mechanism and its effect. Author (TAB)

N66-33840# Space/Defense Corp., Birmingham, Mich.

SURVEY OF METHODS FOR GAS ANALYSIS IN RESPIRATORY ATMOSPHERES Final Report

Donald L. Foster and Michael Brian 20 Apr. 1965 62 p refs

(Contract Nonr-4490(00))

(TR65-102; AD-634039) CFSTI: HC $3.00/MF $0.75

It appears that currently available equipment (or available equipment with minor modification) can be adapted to meet the most basic requirements for respiratory atmosphere analysis. However, the optimum characteristics desired are probably not intrinsic to currently available instrumentation. The most limiting factor appears to be the incapability of a single analytical technique to provide acceptable monitoring of the atmospheric composition. It is almost certain that in any system for atmosphere analysis it will be necessary to utilize equipment employing more than one of the analytical methods in use today. TAB

N66-33981*# TRW Systems, Redondo Beach, Calif.

HUMAN TRACKING PERFORMANCE IN UNCOUPLED AND COUPLED TWO-AXIS SYSTEMS

E. P. Todosiev, R. E. Rose, G. A. Bekey, and H. L. Williams Washington, NASA, Aug. 1966 90 p refs

(Contract NAS1-4419)

(NASA-CR-532) CFSTI: HC $5.00/MF $0.75 CSCL 05H

This report presents the results of an experimental and analytical study of human performance in uncoupled and coupled control systems. Human pilot performance in single and two-axis systems was mathematically modeled by linear second-order describing functions. Manual tracking of two-axis systems with cross-coupling was studied experimentally and analytically. A methodology study compared the identification performance of continuous, iterative, and extrapolation model matching techniques. Author

N66-34047# Human Engineering Labs., Aberdeen Proving Ground, Md.

FURTHER STUDIES OF THE RELIABILITY OF TEMPORARY THRESHOLD SHIFT FROM IMPULSE-NOISE EXPOSURE

David C. Hodge and R. Bruce Mc Commons Apr. 1966 46 p refs

(TM-3-66; AD-634456) CFSTI: HC $2.00/MF $0.50

Three studies were conducted to determine the reliability, under various exposure conditions, of temporary threshold shift (TTS) produced by impulse noise. The subjects, who were representative of the army population, were tested at frequencies throughout the range of human hearing. Individual subjects' TTSs were not consistent enough to permit any meaningful generalizations. However, group-mean TTS was a reliable measure of impulse-noise effects for subjects with both normal and subnormal hearing, and throughout the range

of audible frequencies. Basing interpretations on these types of data should insure that results from various tests will be comparable. Author (TAB)

N66-34069*# California Univ., Berkeley. Space Sciences Lab.
ON LARGE MODELS OF SYSTEMS
C. West Churchman Jun. 1966 22 p Presented at 2d Stony Brook Conf. on Advances in Computing, N. Y., Jun. 1966 *Its* Internal Working Paper No. 39
(Grant NsG-243-62)
(NASA-CR-77105) CFSTI: HC $1.00/MF $0.50 CSCL 05K

A theoretical discussion is presented of difficulties in attempts to rationalize large social systems, such as governments, industrial firms, universities, or hospitals by search for central quantitative measures of system performance. These measures, or desirable qualities, are then related to the feasible activities of the particular system in order to enhance man's understanding of the system; and the mathematics which relates these activities to the desirable quantities is dubbed an objective function. Objective functions can then be maximized by use of constraint equations. While the problems inherent in rationalizing human systems by large models are many, it is emphasized that we should not abandon efforts in this direction. M.W.R.

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N66-32701# Library of Congress, Washington, D. C. Aerospace Technology Div.
POLYTITANOORGANOSILOXANES AND SOME OTHER METAL-CONTAINING POLYMERS
Boris Nartsissov *In its* Foreign Sci. Bull., Vol. 2, No. 6 Jun. 1966 p 10–18 refs (See N66-32699 19-34)

Current information is given on polysiloxanes with chelated or non-chelated titanium or some other quadrivalent elements, e.g., zirconium, in the backbone. Soviet scientists' continued search for metal-containing polymers with desired properties is noted; an approach is made to the solution of this problem by studying the activation energy of viscous flow, and its meaning for determination of the values of a series of other physical constants is noted. In addition, the introduction of a trivalent element, e.g., chromium, into the polysiloxane backbone, and the synthesis of a series of carbon–germanium heterochain polymers is mentioned. In the writer's comment an opinion is expressed on the existence of planned research. Author

N66-32802# International Union of Pure and Applied Chemistry, Basle (Switzerland). Commission on High Temperatures in Gases and on Plasma Chemistry.
BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF GASES AND GAS-CONDENSED PHASE REACTIONS
L. Brewer, comp. (Calif. Univ., Berkeley) 30 Sep. 1965 21 p refs
(Rept.-16) Available from Nat. Bur. of Std., Washington, D. C.

A bibliography is presented on the high temperature chemistry and physics of gases and gas condensed phase reactions. R.N.A.

N66-32809# Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu.
A CONTRIBUTION TO THE EXTRACTION RADIOMETRIC TITRATIONS [K EKSTRAKTSIONNOMU RADIOMETRIKHESKOMU TITROVANIYU]
F. Kukula and M. Krivansk 1965 13 p refs In CZECHOSLOVAKIAN; ENGLISH summary
(UJV-1418/65)

A new simplified method for extraction radiometric titration, which is described, is applicable for the determination of the carrier quantity in radioisotopes and their mixtures. Single elements (Cu, Hg, Ag, Fe) as well as the combinations Hg–Cu and Ag–Cu were estimated in the particular sample. The combination of this method with double-isotopic-dilution makes it possible to carry out experiments with reagents of low stability and/or of insufficient purity. Three different ways for evaluating the titration curves and the applicability of a multichannel analyzer for studying the titration curve for radioisotope mixtures are discussed. Author (NSA)

N66-32856# Mellon Inst., Pittsburgh, Pa. Radiation Research Labs.
[RADIATION RESEARCH] Quarterly Report, Jan. 1–Mar. 31, 1966
15 Apr. 1966 11 p refs
(Contract AT(30-1)-2310)
(RRL-2310-174) CFSTI: HC $1.00/MF $0.50

Developments are reported for studies on: vibrationally excited cyclopropane; photochemistry of 1,3-dioxolane; ESR spectra of fluorinated ethyl radicals; ESR spectra and structure of SF^+ and PF_4; ion recombination in propane radiolysis; mercury photosensitized decomposition of hydrocarbons; tetravalent iron in pulse irradiated ferric perchlorate solutions; and radiation chemical studies with heavy ions. NSA

N66-32858# Delaware Univ., Newark. Dept. of Chemistry.
STUDIES IN CHEMICAL RADIATION PROTECTION AGENTS Progress Report
Conrad N. Trumbore 18 Apr. 1966 11 p
(Contract AT(30-1)-3383)
(NYO-3383-3) CFSTI: HC $1.00/MF $0.50

Studies were continued on the aqueous radiation chemistry of cysteine which acts as a protective agent against ionizing radiation. It was found that cysteine reacts on almost every collision with every known reactive intermediate in radiolyzed water solutions. Thus the complete scavenging ability of this compound for free radicals now has been demonstrated in quantitative fashion for the first time. In continuing studies of the mechanism of reaction of cysteine with irradiated water a new phenomenon was obtained which implies a precursor for the H and OH radicals in acid and possibly in neutral solution. A hypothesis now being tested is that excited water molecules are quenched by cysteine at very low concentrations, with the resulting production of free radicals, which in turn may be scavenged by cysteine. Other studies are exploratory in nature and involve the study of radioresistant algae and some compounds that help to test the above hypothesis. Author (NSA)

N66-32861# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
CHEMICAL PROPERTIES OF ELEMENT 104
I. Zvara, Yu. T. Chuburkov, R. Caletka, T. S. Zvarova, M. R. Shalayevsky et al 1966 5 p refs
(JINR-D-2710)

Using the method of fast continuous separation of the elements of subgroups III B and IV B, the properties of Cm, Cf, Hf, and $^{260}104$ chlorides were compared. Up to now, the

isotope of element 104 has been identified by physical methods only. Now it was found that its chemical properties are different from those of actinide elements and close to Hf. The atomic number of the new nucleus was independently confirmed. It was also found that element 104 belongs to group IV. Twelve atoms of $^{260}104$ were detected. Author (NSA)

N66-32871# Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria).

THE CHEMISTRY OF THE "MOLECULAR PLATING" PROCESS [DER CHEMISMUS DES "MOLECULAR PLATING" VERFAHRENS]

E. Proksch, N. Getoff, H. Bildstein, H. Saukel, H. Eschweiler et al 1966 17 p refs In GERMAN; ENGLISH summary (SGAE-CH-28/66)

Several platings obtained by electrolysis of metal salt solutions highly diluted with certain alcohols or ketones (Molecular Plating process) were investigated by irreflection spectroscopy. With the exception of the noble metals, the primary cathodic deposit consists of hydroxides or oxides, irrespective of the nature of the metal salt used. The anions may be found at the anode provided they are chemically bound there. The electrolytic deposition processes are accompanied by decomposition of the water contained in the solution and by an attack on the organic solvent (dimerization and oxidation), as was found by gas chromatographic analysis Author (NSA)

N66-32892# Nuclear Materials and Equipment Corp., Apollo, Pa.

MORPHOLOGICAL CHARACTERISTICS OF COPRECIPITATED (U, Pu)O_2 POWDERS BY ELECTRON MICROSCOPY

J. Roth and E. K. Halteman [1962] 41 p refs (Contract AT(30-1)-2389) (NUMEC-2389-5) CFSTI: HC $2.00/MF $0.50

Electron microscopy was developed as a tool for studying the characteristics of plutonium-bearing fuel materials. The development of replication techniques necessary to prevent contamination of the electron microscope are discussed herein as are the conclusions that may be drawn from examination of the electron micrographs. While multiple step replication techniques were investigated, a single-step technique was found to be most satisfactory because of the relative ease of preparation, the minimization of artifacts, and the general excellence of resolutions. Examination of (U,Pu)O_2 materials over the entire composition range and the precursors from ammonium diuranate–plutonium hydroxide coprecipitation from uranyl nitrate–plutonium nitrate solutions generally shows that the morphological characteristics of the powders are determined by the initial precipitation chemistry and thereafter are transferred from step to step throughout the oxide production process. Author (NSA)

N66-33046# Israel Program for Scientific Translations, Ltd., Jerusalem.

ACTIVATION ANALYSIS. PROCEEDINGS OF THE FIRST ALL-UNION COORDINATING CONFERENCE

E. M. Lobanov, ed. 1966 149 p refs Transl. into ENGLISH of the book "Trudy i Vsesoyuznogo Koordinatsionnogo Soveshchaniya Po Aktivatsionnomu Analizu" Tashkant, Izd. "Nauka" Uzb. SSR, 1964 Conf. held in Tashkent, 24–28 Oct. 1962 Sponsored by AEC and NSF (AEC-TR-6639; TT-66-51010) CFSTI: $4.00

Conference papers on neutron activation analysis and determination of elements are presented. For individual titles see N66-33047–N66-33073.

N66-33051# Israel Program for Scientific Translations, Ltd., Jerusalem.

NEUTRON-ACTIVATION ANALYSIS OF SPECIAL-PURITY ALUMINUM

T. A. Potapova and T. V. Poleshchuk *In its* Activation Analysis 1966 p 28–31 (See N66-33046 19-06) CFSTI: $4.00

A procedure is described for the determination of copper, manganese, zinc, gallium, cadmium, iron, and gold in specimens of special purity aluminum by neutron activation analysis. The impurity contents as given by this method are provided, and a comparison is made between the results of neutron activation and standard chemical analysis of copper and iron. H.S.W.

N66-33052# Israel Program for Scientific Translations, Ltd., Jerusalem.

DETERMINATION OF NITROGEN IN ORGANIC COMPOUNDS BY FAST-NEUTRON ACTIVATION

V. I. Shamaev *In its* Activation Analysis 1966 p 32–35 ref (See N66-33046 19-06) CFSTI: $4.00

Nitrogen in organic compounds was determined by the nuclear reaction $N^{14}(n,2n)N^{13}$. The analyses were made by comparing the measured activity with the activity of irradiated compounds of known nitrogen content. In this investigation, strontium was chosen as the comparison element. The analytical procedure is outlined and the advantages of this proposed method of nitrogen analysis are assessed. H.S.W.

N66-33053# Israel Program for Scientific Translations, Ltd., Jerusalem.

NEUTRON-ACTIVATION ANALYSIS OF SILICA USING ION-EXCHANGE CHROMATOGRAPHY

V. V. Moiseev, R. A. Kuznetsov, and A. I. Kalinin *In its* Activation Analysis 1966 p 36–41 refs (See N66-33046 19-06) CFSTI: $4.00

In the neutron activation analysis of silicon dioxide, chemical deposition of the samples was employed with subsequent separation of the activated microimpurities by ion-exchange chromatography. The separation procedure is outlined, and a method for identification of the separated groups by gamma spectrometry is discussed. H.S.W.

N66-33054# Israel Program for Scientific Translations, Ltd., Jerusalem.

DETERMINATION OF IMPURITIES IN SILICON CARBIDE

G. V. Leushkina, E. M. Lobanov, V. I. Zvyagin, and A. G. Dutov *In its* Activation Analysis 1966 p 42–45 refs (See N66-33046 19-06) CFSTI: $4.00

Upon irradiation with reactor neutrons, interference is incurred in the determination of impurities in silicon carbide from the fast neutron reaction $Si^{28}(n,p)Al^{28}$; therefore it is necessary to establish the maximum concentration of Al produced in this reaction. This represents the lowest Al concentration which can be determined by neutron activation analysis. The analytical procedure for this determination is discussed and a table showing the results of the activation analysis of SiC is provided. H.S.W.

N66-33055# Israel Program for Scientific Translations, Ltd., Jerusalem.

ACTIVATION ANALYSIS OF SOME ORGANIC COMPOUNDS

L. A. Smakhtin, N. V. Filippova, and V. K. Brovtsyn *In its* Activation Analysis 1966 p 46–49 (See N66-33046 19-06) CFSTI: $4.00

Experiments were conducted on the determination of manganese and bromium in gasoline by activation analysis, and the analytical procedure is outlined. The analysis of a mixture not weighing more than 0.5 g can be completed in 24 hours, and the sensitivity of the method makes it suitable for determining

low concentrations of manganese and bromium with fairly high accuracy. The method was also used to analyze various grades of polyethylene, and the data obtained from these analyses are shown. H.S.W.

N66-33056# Israel Program for Scientific Translations, Ltd., Jerusalem.

USE OF NEUTRON-ACTIVATION ANALYSIS IN PROSPECTING FOR MINERALS

D. I. Leipunskaya *In its* Activation Analysis 1966 p 50–54 refs (See N66-33046 19-06) CFSTI: $4.00

Some of the advantages of neutron activation analysis from the standpoint of an analytical geological survey are listed and used as a basis for the discussion. The limits of effective applicability of neutron activation methods are determined by the elementary composition of the object in question, the available conditions of irradiation, and the means of recording the induced radioactivity. Tables are provided which give the types of compact neutron sources used in neutron activation analysis and their operation characteristics, and the minimum concentration of some elements that have been determined by activation analysis. It is stated that this technique favors the development of economical large scale analysis of mineral samples, in addition to methods of neutron activation logging. H.S.W.

N66-33057# Israel Program for Scientific Translations, Ltd., Jerusalem.

DETERMINATION OF TRACE AMOUNTS OF GOLD IN ROCKS AND SEDIMENTARY FORMATIONS BY THE NEUTRON-ACTIVATION METHOD WITHOUT DECOMPOSITION OF THE SAMPLE

G. A. Perezhogin and I. P. Alimarin *In its* Activation Analysis 1966 p 55–59 refs (See N66-33046 19-06) CFSTI: $4.00

Means for lowering the interference in neutron activation analysis in determinations of gold in rocks and sediment are discussed. One method involves graphically plotting the activity of the principle radioisotope to the activity of the interfering radioisotope. The second method discussed employs resonance neutrons for activation. The results of experiments conducted using these methods are evaluated. H.S.W.

N66-33058# Israel Program for Scientific Translations, Ltd., Jerusalem.

A MORE EFFECTIVE DETERMINATION OF GOLD IN ORES BY ACTIVATION ANALYSIS

E. M. Lobanov, I. A. Miranskii, V. F. Pozychanyuk, D. G. Saifutdinova, and A. A. Khaidarov *In its* Activation Analysis 1966 p 60–63 refs (See N66-33046 19-06) CFSTI: $4.00

Due to the unfavorable concentration of interfering elements, it was determined that gold could not be determined by activation analysis when present in amounts of less than 3 g/ton. It was found that by irradiating auriferous ore samples in cadmium shells, the proportion of background activity in the total spectrum of the sample can be reduced, thereby making possible quantitative determinations with gold concentrations of the order of 0.1 g/ton. H.S.W.

N66-33059# Israel Program for Scientific Translations, Ltd., Jerusalem.

FAST NEUTRON-ACTIVATION DETERMINATION OF SODIUM AND POTASSIUM IN SMALL POWDERED SAMPLES OF ALUMOSILICATE ROCKS

D. I. Leipunskaya and N. D. Putyatina *In its* Activation Analysis 1966 p 64–66 refs (See N66-33046 19-06) CFSTI: $4.00

Results of determinations of sodium and potassium in alumosilicate rocks by fast neutron activation analysis are presented and assessed. The procedure used is discussed and the theoretical data obtained agreed with the experimental data to within ±10%. The equations for calculating the concentrations of sodium and potassium are provided. H.S.W.

N66-33060# Israel Program for Scientific Translations, Ltd., Jerusalem.

DETERMINATION OF IMPURITIES IN BORON AND IN QUARTZ CRYSTALS BY THE NEUTRON-ACTIVATION METHOD

E. M. Lobanov, A. I. Chanyshev, A. G. Dutov, A. Khudaiberganov, and M. G. Ashirov *In its* Activation Analysis 1966 p 67–69 (See N66-33046 19-06) CFSTI: $4.00

Details are given on a gamma spectroscopic activation analysis of boron specimens and quartz crystals in which the samples are not decomposed. Activation was by irradiation in the thermal channel of the reactor. The gamma spectra were taken with a multichannel scintillation gamma spectrometer consisting of a NaI(Tl) crystal 40 mm in diameter and 50 mm high, a photoelectric multiplier, and a 100-channel pulse height analyzer. For identifying isotopes from their energies in the soft and hard regions of the gamma spectrum, the analyzer scale was preliminarily calibrated for various gain factors of the preamplifier. The impurities are identified directly from the energies of the gamma lines observed in the spectrum; the half-life of individual gamma lines are also measured. The spectra are repeatedly taken at constant time intervals, and changes in the intensities of the relevant lines are noted. Corrections are introduced to allow for the strong absorption of neutrons in boron. The gamma spectrum of an irradiated boron sample containing Cu, Mn, and Na impurities is depicted, and the impurities detected in quartz crystals are identified. M.G.J.

N66-33061# Israel Program for Scientific Translations, Ltd., Jerusalem.

DETERMINATION OF ALUMINUM IN KAOLIN CLAYS BY THE NEUTRON-ACTIVATION METHOD

E. M. Lobanov, A. I. Chanyshev, A. G. Dutov, M. G. Ashirov, and A. Khudaiberganov *In its* Activation Analysis 1966 p 70–73 refs (See N66-33046 19-06) CFSTI: $4.00

Based on the neutron nuclear characteristics of the elements contained in clays and the given neutron flux, the expected γ activities of isotopes with half lives and γ line energies close to those of Al^{28} were calculated for various irradiation times. The activity decay curves were plotted against time to determine the time of irradiation and measurement. As kaolin clays contain considerable amounts of silicon the interference due to the fast neutron reaction $Si^{28}(n,p)Al^{28}$ was reduced by irradiating the specimens in the thermal channel of the reactor. To reduce errors caused by neutron absorption, the size and weight of the specimen was chosen to ensure fairly low self-shielding. The γ-spectra of the irradiated specimens were measured with a multichannel scintillation gamma spectrometer. The energy scale was linear, and the energy resolution was 11% for Cs^{137}. An apparatus designed for aluminum determination in kaolin is briefly discussed. M.G.J.

N66-33062# Israel Program for Scientific Translations, Ltd., Jerusalem.

DETERMINATION OF COPPER IN CORES BY ACTIVATION ANALYSIS

E. M. Lobanov, A. P. Nevikov, A. I. Chanyshev, A. G. Dutov, M. G. Ashirov et al *In its* Activation Analysis 1966 p 74–77 refs (See N66-33046 19-06) CFSTI: $4.00

Core samples from 10 wells collected at various depths were used in experiments to evaluate the suitability of neutron activation analysis for large scale fast determination of copper content. Chemical components of the core sample and the neutron nuclear characteristics of its component elements are tabulated. Samples with known copper content were weighted

and 2 g standard specimens were prepared. The standards were neutron irradiated in a reactor thermal column, with irradiation time chosen to produce Cu^{66} gamma radiation of sufficient intensity. From data on the initial intensity of the Cu^{66} gamma line and the copper content in the standards, a calibration graph was plotted from which the copper content in the samples could be determined. Details of the analysis are presented. For measuring the gamma spectra, a scintillation spectrometer was used consisting of a 40×50 mm NaI(Tl) crystal, a photomultiplier, a cathode follower, and a multichannel pulse height analyzer. It was concluded that the Cu^{64} reference isotope is faster than the Cu^{66} for determining the copper content. Activation and chemical analytical results were found to be in satisfactory agreement. M.G.J.

N66-33063# Israel Program for Scientific Translations, Ltd., Jerusalem.

LARGE-SCALE DETERMINATION OF COPPER IN CORES BY THE NEUTRON-ACTIVATION METHOD

E. M. Lobanov and A. I. Chanyshev *In its* Activation Analysis 1966 p 78–81 refs (See N66-33046 19-06) CFSTI: $4.00

In the core samples analyzed, the comparatively long-lived Cu^{64} was selected as the analytical isotope. Manganese and sodium are the main interfering elements, with the cores containing 0.05% to 2% copper, 0.01% to 0.3% manganese, and 0.1% to 5% sodium. Samples weighing 2 g were used, as this weight is geologically representative, and ensures satisfactory statistics, radiation safety, and minimum error due to screening of inner samples by outer samples in the common cartridge used in simultaneous irradiation. Irradiation was timed to obtain sufficient gamma activity of Cu^{64}, based on theoretical calculations of the expected activity of various isotopes in the sample. The artificial radioactivity of the samples was measured with an apparatus consisting of a scintillation spectrometric element, a one-channel pulse height analyzer, and two radiometers used as scalers. Figures depict the gamma spectra of irradiated standards, and the calibration graph plotted by measuring the intensity for $CuSO_4 \cdot 5H_2O$ samples with known Cu content. The results obtained with activation and chemical analyses are tabulated, and the accuracy of measurements is found to be close to 10%. M.G.J.

N66-33064# Israel Program for Scientific Translations, Ltd., Jerusalem.

APPLICATION OF NEUTRON-ACTIVATION ANALYSIS TO THE DETERMINATION OF COPPER IN BENEFICIATION PRODUCTS

I. N. Plaksin, Ch. A. Aleksandrov, and L. P. Starchik *In its* Activation Analysis 1966 p 82–85 refs (See N66-33046 19-06) CFSTI: $4.00

For determining copper content in beneficiation products, nuclear gamma spectroscopy is recommended as the most effective means of eliminating the influence of such elements as aluminum, silicon, and zinc. The method permits measurement of the intensity of gamma quanta of definite energy, i.e., determination of the content of a given element by its gamma activity in the presence of other elements emitting both gamma and beta radiation. The scintillation gamma spectrometer used to determine copper from its gamma activity is described, and a calibration graph showing the copper channel count, silicon channel count, and the copper determination is included. Figures depict the gamma spectrum of a sample containing $20\%SiO_2 + 40\%FeS_2 + 10\%ZnS + 30\%CuO$. It was found that the relative error in determining copper by neutron activation in conjunction with gamma spectroscopy is 2.5% to 3% for concentrates; this error is considered satisfactory for the control requirements in beneficiation plants. M.G.J.

N66-33065# Israel Program for Scientific Translations, Ltd., Jerusalem.

DETERMINATION OF RARE-EARTH ELEMENTS IN ACCESSORY MINERALS BY THE NEUTRON-ACTIVATION METHOD

E. M. Lobanov, A. Babaev, and D. Nurmatov *In its* Activation Analysis 1966 p 86–91 refs (See N66-33046 19-06) CFSTI: $4.00

The properties of rare earths are discussed, and the various methods used in analyzing these elements are assessed. As these techniques often involve considerable losses of time and material, a procedure is proposed for determining rare earths in the composition of accessory minerals without preliminary chemical decomposition of the mineral samples. The induced activity was measured with a scintillation gamma spectrometer consisting of a NaI(Tl) crystal, a photomultiplier, a high voltage source, and a 100-channel pulse height analyzer. The gamma spectrometer was calibrated using known lines of the isotopes Hg^{203}, Cs^{137}, Mn^{56}, Co^{60} and Na^{24}, and the gamma lines of the radioactive isotopes produced by irradiating standards. The energy scale was linear with 12.5% resolution for the half width of the Cs^{137} photopeak. Analytical details are given, and the nuclear characteristics of the principal elements in monazite are tabulated. Characteristic gamma spectra of irradiated monazite are plotted. It was concluded that determination of the rare earths from their characteristic gamma lines and half lives provides a short and simple method of analysis. M.G.J.

N66-33066# Israel Program for Scientific Translations, Ltd., Jerusalem.

THE POSSIBILITY OF DETERMINING SILVER IN SOLUTION BY THE NEUTRON-ACTIVATION METHOD

I. N. Plaksin, P. M. Petrov, L. P. Starchik, and G. B. Stogova *In its* Activation Analysis 1966 p 92–96 refs (See N66-33046 19-06) CFSTI: $4.00

The nuclear characteristics of the principal elements interfering with the determination of silver are discussed in relation to the use of nuclear spectroscopy as a method of eliminating, or allowing for, the interference of these impurity activities. It is pointed out that nuclear gamma spectroscopy is suitable for measuring the intensity of gamma quanta of a certain energy, i.e., for determining the content of an element from its gamma activity in the presence of other elements. Procedures for determining silver in the presence of copper, zinc, and sodium are described. A calibration graph for silver in solutions of various concentrations is included which shows that initially the concentration is directly proportional to the count; later, the linear dependence is disturbed due to absorption and attenuation of the neutron flux and the self-absorption of gamma quanta in silver-rich solutions. This departure from linear dependence is considered to be due to the self-absorption of gamma quanta of Ag^{108}. Methods used to study this phenomenon are reviewed. It is concluded that the proposed procedure can be used to rapidly determine silver in intermediate flotation products in ore beneficiation installations. M.G.J.

N66-33067# Israel Program for Scientific Translations, Ltd., Jerusalem.

GAMMA-SPECTROMETRIC DETERMINATION OF CESIUM BY THE NEUTRON-ACTIVATION METHOD

I. N. Plaksin, M. A. Belyakov, and L. P. Starchik *In its* Activation Analysis 1966 p 97–102 refs (See N66-33046 19-06) CFSTI: $4.00

The principles of neutron activation are discussed, and the count intensity of the gamma quanta emitted in isomeric transition is measured to obtain a quantitative determination of cesium. Methods of eliminating interference from other elements in the samples are described, and equations are

formulated for correcting errors caused by self-absorption. Pollucite, $CsAlSi_2O_6$, was used as the cesium-bearing mineral. After activation in a neutron flux of a polonium–beryllium source of some $1.5 \cdot 10^7$ neutron/sec moderated in a paraffin layer, the sample was placed in the lead shielding of a universal scintillation element on a NaI(Tl) spectrometric crystal 30 mm in diameter and 10 mm high. The output signal of the element was fed to the input of a differential pulse height analyzer, and then recorded. Measurement results are assessed, and a calibration graph is included to show the pulse count vs the cesium content in a pollucite–microcline mixture, with and without correction for self-absorption. M.G.J.

N66-33068# Israel Program for Scientific Translations, Ltd., Jerusalem.

DETERMINATION OF TANTALUM IN ROCKS AND MINERALS BY THE NEUTRON-ACTIVATION METHOD

M. B. Shiryaeva and Yu. P. Salmin *In its* Activation Analysis 1966 p 103–107 (See N66-33046 19-06) CFSTI: $4.00

The nuclear characteristics of Ta^{181} are listed, and a procedure of activation analysis of clarke contents of tantalum (0.0002%) is discussed. The content of tantalum was determined in samples of rocks, ores, and minerals weighing from 5 to 200 mg. Liquid and dry powdered standards and the samples were sealed in 30 mm high quartz ampuls with inner diameters between 12.8 and 12 mm. The ampuls were placed in a standard aluminum container, irradiated in a flux of some 10^{12} neutron/cm^2-sec for 24 hours, and left to cool for 4 to 8 days. Theoretical calculation shows that the sensitivity threshold of activation analysis of tantalum under the given conditions of activation and measurement is $2 \cdot 10^{-5}$% tantalum pentoxide. The sensitivity limit is determined by the burn-out of tantalum (10^{-7}% to 10^{-8}%). Experimental results are assessed, and it is pointed out that the errors introduced depend both on the reactor employed and on the tungsten and rhenium content. M.G.J.

N66-33069# Israel Program for Scientific Translations, Ltd., Jerusalem.

FAST RADIOCHEMICAL SEPARATION IN ACTIVATION ANALYSIS OF BIOLOGICAL MATTER

A. A. Kist, L. S. Zvyagina, E. M. Lobanov, A. I. Nikolaev, and V. I. Zvyagin *In its* Activation Analysis 1966 p 108–113 refs (See N66-33046 19-06) CFSTI: $4.00

Activation analysis procedures were used to determine some elements in cerebral tumors and the brain tissue of rats, and the results are presented on a series of determinations of magnesium and cobalt which entailed fast radiochemical isolation. It is pointed out that of 54 elements detected in organism, 24 are adapted to fast analysis. A table gives the characteristics of these elements, the sensitivity of activation, and other analytical procedures used for trace amounts of elements. The treatment processes are described, and the problem areas encountered are identified. Although the sensitivity of the magnesium determination is comparatively low, satisfactory results were obtained due to the high magnesium content in the cerebral tissue. However, measurements of the decay of total cobalt activity did not give satisfactory results. This is believed due to the low activity and low efficiency of the available counters for the soft gamma rays of Co^{60m}. M.G.J.

N66-33073# Israel Program for Scientific Translations, Ltd., Jerusalem.

DETERMINATION OF TUNGSTEN IN SOLUTIONS BY THE METHOD OF ABSORPTION OF SOFT GAMMA-QUANTA

I. N. Plaksin, E. V. Anchevskii, E. I. Russkaya, and L. P. Starchik *In its* Activation Analysis 1966 p 126–130 refs (See N66-33046 19-06) CFSTI: $4.00

For determining tungsten in solutions, a Tu^{170} source with a half life of 129 days was used; total radiation comprised 13.6% of 84 keV gamma quanta, 18.2% of 52 keV X-rays, and 68.2% of X-rays of energies of 7 to 8 and 2 keV. The solution was poured into a cylindrical beaker, with the volume chosen to minimize the statistical error. To determine absorptivity, the solution was placed in a collimated beam of gamma quanta; the holder with the sample was mounted on the centering ring of a moving plank (the ring preserves the geometry of irradiation). The plank with the holder was moved into the working zone, after which the number of gamma quanta passing through the sample was counted. Figures depict the calibration graph used to determine the content of WO_3 in solutions of concentration between 80 and 200 g/l, and the influence of Na_2CO_3 on the determination of WO_3. M.G.J.

N66-33084# Joint Publications Research Service, Washington, C. D.

EFFECT OF AN EXPLOSION OF MATTER: DYNAMIC COMPRESSION OF POTASSIUM NITRATE

S. S. Batsanov, A. A. Deribas, Ye. V. Dulepov, M. G. Yermakov, and V. M. Kudinov *In its* Studies in Phys. of Combust. and Explosion (No. 4, 1965) 25 Jul. 1966. p 54–60 refs (See N66-33077 19-33) CFSTI: $3.00

Explosions of poured hexogene were used to investigate the dynamic compression of polycrystalline potassium nitrate. Experiments were conducted in three different devices: a steel ampoule of 40 mm height with an inner diameter of 5 mm, into which 0.2 to 1.2 g of the KNO_3 was placed; a steel ampoule with the same internal volume, but with a conical base which was screwed onto a massive steel slab to facilitate rapid heat transfer; and a flat steel ampoule for studying plane compression. A flat copper ampoule was also used. Of the two phases that formed after the explosion, the red phase was disregarded, and the white phase was chemically analyzed. Examined were composition, density, refraction index, and specific inductive capacitance. Thermograms and X-ray photographs were taken, and during the study of phase changes a new maximum frequency of 832 cm^{-1} was observed in the infrared absorption spectrum. The effect of temperature variations subsequent to the explosions was studied, and repeated heating to 55° C resulted in a transformation of the new phase into an ordinary modification of the KNO_3. K.W.

N66-33087# United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.

HIGH TEMPERATURE VAPORISATION STUDIES BY MASS SPECTROMETRY. I: THE COINAGE METALS. A DISCUSSION OF THE METHOD AND ERRORS

D. F. Avery, J. Cuthbert, M. J. D. Prosser, and C. Silk Mar. 1966 24 p refs (AERE-R-5094)

The vaporization of the coinage metals was studied using a mass spectrometer equipped with a high temperature furnace and molecular beam system. The Knudsen equation, the measured sensitivity of the mass spectrometer, and the molecular beam geometry were used to calibrate the instrument for absolute values of the pressures in the Knudsen cell. Random errors within an experiment were found to be 2–3% in the second law heats of vaporization and 0.3–0.7% in the third law heat of vaporization at standard temperature. Unknown changes in instrumental conditions between experiments may introduce additional errors of up to 3% in the third law values; the calibration procedure is therefore shown to be as satisfactory as other conventional methods. Heats of vaporization

determined for the coinage metals (Cu, 82.4; Ag, 67.1; Au, 85.5, ±3 kcal/g.atom) agree well with the accepted values quoted in the literature. Author

N66-33088# United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.
THE GAMMA SPECTRUM OF PRASEODYMIUM-145
R. J. Bullock and N. R. Large Mar. 1966 18 p refs
(AERE-R-5170)

The γ-ray spectrum of ^{145}Pr has been investigated up to 1.5 Mev and the abundances of the γ-rays determined. Peaks were observed at 0.0723 (0.20%), 0.674 (0.51%), 0.749 (0.43%), 0.979 (0.18%), 1.054 (0.17%), and 1.156 (0.15%) Mev, and a peak at 1.45 Mev may be associated with ^{145}Pr but this has not been confirmed. The peak at 0.0723 Mev may be suitable for Mössbauer studies. Author

N66-33092# United Kingdom Atomic Energy Authority, Harwell (England). Chemical Engineering Div.
FOAM SEPARATION
F. Wace and D. L. Banfield Apr. 1966 22 p refs
(AERE-R-5189) CFSTI: HC $1.00/MF $0.50

The genesis and development of this novel separation process is briefly reviewed. Rational design methods, based on surface equilibria and bubble dynamics, are presented. Comparisons are drawn with other extraction processes. Foam separation is capable of only very low solute throughput but has nevertheless several specialized applications. Author

N66-33104# United Kingdom Atomic Energy Authority, Harwell (England). Chemical Engineering Div.
THE FINGAL PROCESS
J. R. Grover, W. H. Hardwick, R. Gayler, and M. H. Delve Mar. 1966 26 p refs Presented at the Symp. on the Solidification and Long-Term Storage of Highly Radioactive Wastes, Richland, Wash., 14–18 Feb. 1966
(AERE-R-5188)

The results and practical experience gained during four years operation of the FINGAL pilot plant and the supporting inactive plant are described. Of the 72 runs which have been carried out, 8 have been with actual radioactive fission product solutions. A total of 30,000 curies have been processed, the final run of the programme involving 14,500 curies in 52 l of solution to produce 42 kg of glass. The decontamination factor to the condensate for fission product elements other than ruthenium has been 10^{10} and for ruthenium has varied from 10^{4}–10^{8}. For all activity the decontamination factor to the effluent gas has been 10^{14}–10^{16}. Operating problems due to the presence of ruthenium have been overcome and the process is now ready for commercial exploitation. Author

N66-33106# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.
INTRODUCTION TO THE PHYSICAL CHEMISTRY OF CERAMIC SURFACES
P. J. Anderson Apr. 1966 25 p refs Submitted for Publication
(AERE-M-1734) CFSTI: HC $1.00/MF $0.50

An outline is presented relating to the nature of adsorbents which can be found from the study of adsorption and related phenomena, and which are particularly important to ceramics research. Surface energy, tension, and structure are discussed; attention is given to gas adsorption on solid surfaces; and surface area and pore structure determination from isotherms is considered. The discussion is confined to a presentation of general concepts. M.W.R.

N66-33129# United Kingdom Atomic Energy Authority, Culham (England). Theoretical Physics Div.
A COMPARISON OF GAS PHASE REACTION CALCULATIONS CARRIED OUT ON THE RADIATION INDUCED REACTION BETWEEN CARBON DIOXIDE AND GRAPHITE
J. H. Tait Mar. 1966 14 p refs
(AERE-R-5181) HMSO:2s 6d

In this paper theoretical work on the diffusion of species produced by the irradiation of carbon dioxide and their attack on graphite is compared with previous studies. The former dealt with the attack on the outer surface of the graphite while the latter was concerned mainly with the in pore attack. The two treatments are basically the same, starting with the one velocity group diffusion equation. It is shown that it is just possible to account for the observed inhibition of the in-pore attack by the addition of carbon monoxide to the carbon dioxide on an oxygen atom mechanism. Author

N66-33158# Bureau of Mines, Rolla, Mo.
INFRARED SPECTROSCOPY STUDIES OF A XANTHATE GALENA SYSTEM
R. E. Coleman and H. E. Powell 1966 22 p refs
(BM-RI-6816)

The molecular species occurring at the mineral–reagent interface of the galena–aqueous potassium ethyl xanthate system was studied by developing a technique for using an attenuated reflection method in conjunction with standard infrared spectra of all galena surfaces treated in the pH range of 7 to 11. At pH 8.5, lead ethyl xanthate formed as a film chemically bonded to the galena surface. A solvent extraction sampling method was employed with infrared spectroscopy to obtain quantitative data on the lead ethyl xanthate removed from the galena surface. The data showed that between pH 7 and 11 the quantity of lead ethyl xanthate physically adsorbed decreased as the pH was decreased; in the same pH range, the quantity of free lead ethyl xanthate in the aqueous medium remained constant, and the amount of unreacted xanthate varied. Author

N66-33160# Bureau of Mines, Salt Lake City, Utah.
DETERMINATION OF CESIUM AND RUBIDIUM BY FLAME PHOTOMETRY
Kenneth R. Farley and H. E. Peterson 1966 26 p refs
(BM-RI-6820)

The Bureau of Mines developed a rapid and accurate flame photometric procedure for determining cesium and rubidium in ores and in products associated with the extractive metallurgy of these elements. The effect of associated ions is neutralized by addition of buffer solution; alkali metal effects are neutralized by parallel analyses made on standard solutions similar in composition to the sample being studied. The overall accuracy of the method is within 2.5 pct of the amount of cesium or rubidium present; the range from 1 to 25 pct is the most accurate. Author

N66-33163# International Union of Pure and Applied Chemistry, Basle (Switzerland).
BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF GASES AND PLASMAS
L. Brewer, comp. (Calif. Univ., Berkeley) 30 Jun. 1966 20 p refs
(Rept.-19) Available from Natl. Bur. of Std., Washington, D. C.

A bibliography on the high temperature chemistry and physics of gases and plasmas is given. Spectroscopic studies, and reactions between gases and condensed phases are emphasized. Areas covered include quantum mechanics, ionized states, excited states, spectral line intensities, rotational and vibrational bands of chemical bonds, polarization, resonance fluorescence, dissociation energies, vapor pressures, kinetics, thermodynamics, and mechanisms. L.S.

N66-33165# International Union of Pure and Applied Chemistry, Basle (Switzerland).

BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF MATERIALS IN THE CONDENSED STATE, VOLUME 1966, NUMBER 2

J. J. Diamond, ed. (Natl. Bur. of Std., Washington, D. C.) Jun. 1966 85 p refs

Available from Natl. Bur. of Std., Washington, D. C.

A bibliography on the high temperature chemistry and physics of metallic, non-metallic, and mixed materials in the condensed state is given. The subject areas covered are divided into: (1) devices for achieving temperatures above 1500°C, (2) devices for measuring and controlling temperatures above 1500°C, (3) devices for physical measurements at temperatures above 1000°C, (4) properties of metallic, non-metallic, and mixed materials which melt above 1500°C, at temperatures below 1000°C, (5) properties of metallic, non-metallic, and mixed materials which melt above 1500°C, at temperatures above 1000°C, (6) properties of metallic and non-metallic materials which melt below 1500°C, at temperatures above 1000°C, (7) phase equilibria, (8) reactions at temperatures above 1000°C, and (9) books. L.S.

N66-33166*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

FORMATION OF CO_2 RADICAL IONS WHEN CO_2 IS ADSORBED ON IRRADIATED MAGNESIUM OXIDE

Jack H. Lunsford and John P. Jayne 20 Oct. 1964 10 p refs Submitted for Publication

(NASA-TM-X-54842) CFSTI: HC $1.00/MF $0.50 CSCL 07C

The electron paramagnetic resonance (EPR) spectrum of CO_2 adsorbed on ultraviolet irradiated degassed MgO was observed and compared with the EPR spectrum of the CO_2 radical ion. Spectra were also observed for unirradiated MgO that had been degassed and exposed to CO_2. The ultraviolet light apparently promotes electrons into traps that exist on the surface of the degassed MgO. The resulting EPR spectrum is characteristic of a center having rhombic symmetry. However, the S center does not have rhombic symmetry. A comparison of g-values for the spectrum of CO_2 adsorbed on ultraviolet irradiated MgO with the spectrum of CO_2^- radical ions in gamma irradiated sodium formate single crystals shows that within experimental error there is complete agreement. As a result of the similarity in the spectra and the analysis by Ovenall and Whiffen of the structure of the CO_2^- radical ion, it is concluded that CO_2 adsorbs on irradiated MgO as a planar radical ion. The EPR spectrum of CO_2 unirradiated MgO shows no CO_2^- radical ions. R.N.A.

N66-33168*# Chicago Univ., Ill. Enrico Fermi Institute for Nuclear Studies.

CHEMICAL ANALYSIS OF SURFACES USING ALPHA PARTICLES

James H. Patterson (Argonne Natl. Lab.), Anthony L. Turkevich, and Ernest Franzgrote (Jet Propulsion Lab.) Jul. 1964 79 p refs Submitted for Publication

(Grant NsG-127-61)

(NASA-CR-59458; EFINS-64-42) CFSTI: HC $3.00/MF $0.75 CSCL 07D

The chemical analysis of surfaces using alpha particle interactions has been investigated. Simple instruments incorporating Cm^{242} alpha sources and semiconductor silicon detectors are described. The characteristic energy spectra of alpha particles scattered at large angles from thick targets of different elements have been determined. The relative intensities of scattering by different elements have been established. They show large enhancement over Rutherford scattering for elements lighter than sodium due to nuclear effects. The production of protons from (α,p) reactions in certain elements increases the sensitivity of the method for these elements. The theoretical basis for the quantitative interpretation of scattering spectra from complex materials is developed. The technique appears to be suitable for instrumented space missions. Author

N66-33176*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

THE X-IRRADIATION OF HYDRAZINE AND 1,1-DIMETHYLHYDRAZINE

Harold Lucien and Murray L. Pinns 18 Sep. 1964 13 p refs Submitted for Publication

(NASA-TM-X-54948) CFSTI: HC $1.00/MF $0.50 CSCL 07C

Hydrazine and 1,1-dimethylhydrazine were irradiated at room temperature in both the liquid and the vapor phase with 0.1 to 1.0 Å X-rays at intensities of 1×10^2 to 1×10^3 roentgens per minute and with total doses up to 2.3×10^6 rads. This resulted in 0.3- to 31-percent decomposition with decreasing sensitivity to X-radiation as follows: hydrazine vapor, 1,1-dimethylhydrazine vapor, 1,1-dimethylhydrazine liquid, and hydrazine liquid. Author

N66-33227# Thiokol Chemical Corp., Denville, N. J. Reaction Motors Div.

CARBORANE-SILOXANE ELASTOMERS Quarterly Report, 19 Feb.-18 May 1966

Joseph Green [1966] 27 p refs

(Contract DA-11-070-AMC-852(W))

(RMD-5065-Q5; AD-633528) CFSTI: HC $2.00/MF $0.50

The carborane silane monomers, bis(1-chlorodimethylsilyl-o-carboran-2-yl) propane and bis(1-methoxydimethylsilyl-o-carboran-2-yl) propane, were synthesized and copolymerized to a carborane polysiloxane. Thermal characterization of the polymer by TGA and DTA in air and nitrogen indicated thermal stability to 350°C with no oxidation evident until over 400°C. The thermal data illustrate the 'protective action' of carborane and its ability to stabilize neighboring groups to thermal oxidative degradation. Author (TAB)

N66-33236# Harvard Univ., Cambridge, Mass.

RESEARCH ON CHEMISTRY AND PHYSICS OF INORGANIC SYSTEMS UNDER EXTREME HIGH PRESSURE AND TEMPERATURE Final Report, May 1, 1960-Oct. 31, 1965

C. S. Hurlbut, Jr. Bedford, Mass., AFCRL, 1 Dec. 1965 99 p refs

(Contract AF 19(604)-7319)

(AFCRL-66-152; AD-633148) CFSTI: HC $3.00/MF $0.75

Using the tetrahedral press and uniaxial press, experiments were carried out on SiO_2, $CaCO_3$, FeS_2 and Al_2SiO_5. The quartz-coesite equilibrium was established at 350°C and 23 kb. Calcite and aragonite were synthesized from each other. The breakdown of marcasite to pyrite was determined as a function of pressure and temperature. The univariant point of the three polymorphs of Al_2SiO_5 was determined as 300°C (±50°C) at 8 kb (±0.05 kb). Experiments to synthesize highly pure quartz were carried out at first in alloy steel autoclaves and finally in palladium cans within the autoclaves. The purity of the quartz is dependent both on the purity of the container and of the starting materials. High purity quartz (impurities less than 10 ppm) was grown in a palladium can from high-purity crystallized high-purity silica glass. Single crystals of alpha-AsS were synthesized from natural realgar, beta-AsS. The synthesized crystals are shown to be triclinic. Author (TAB)

N66-33283# Naval Ordnance Lab., Corona, Calif.

CHEMOELECTRIC ENERGY CONVERSION FOR NON-AQUEOUS RESERVE BATTERIES Eleventh Quarterly Report, Jan.-Mar. 1966

Richard E. Panzer, Gerald E. Mc Williams, and W. S. Harris 15 Apr. 1966 20 p refs
(NAVWEPS-8853; AD-633957) CFSTI: HC $1.00/MF $0.50

Although cyanamide may be useful as an acid for organic nitro compounds in a voltaic cell, the advantages sought are insufficient to warrant further effort at this time. Metal nitride reference electrodes were tested in hardware-cell assemblies, but no suitable electrolyte separator has yet been devised to permit reproducible and stable operation. A study was begun of limiting potentials for redox reactions in NH_3 electrolytes on various electronically conducting substrates (cathectors), such as Pt, Ag, Ni, stainless steel, and pyrolytic graphite. Tests also began on several types of porous conductive cathector matrices. Study began on soluble fuel-cell reactants, such as solutions of sulfur and organic nitro compounds in anhydrous ammonia. A Li–S fuel cell could be made with both electrode reactants in solution. This cell has a high theoretical energy of 11 J/mg, as compared with 12 J/mg for the H_2–O_2 fuel-cell couple (both exceed 1000 Wh/lb). Preliminary coulometric reduction of S in concentrated NaSCN–NH_3 solution showed the expected two-electron total reaction occurred at low rate. Cyclic voltammetric measurements of reduction potentials of S solutions on Hg or Pt surface have been satisfactory, because of interfering reactions. Author (TAB)

N66-33367*# Princeton Univ., N. J.
ABSORPTION SPECTRUM OF THE NO MOLECULE. V: SURVEY OF EXCITED STATES AND THEIR INTERACTIONS
K. Dressler and E. Miescher (Basel Univ.) [1964] 39 p refs Submitted for Publication
(Grants NsG-414; AF-EOAR-63-109)
(NASA-CR-59449) CFSTI: HC $2.00/MF $0.50 CSCL 07D

New analyses of absorption bands of NO, based on high resolution spectrograms of three isotopic NO molecules in the wavelength region 1550–1400 Å, are reported. The rotational and vibrational structures as well as the intensities of the observed bands are largely determined by the numerous interactions found between Rydberg-type and non-Rydberg-type energy levels of identical symmetry. Several new Rydberg states of symmetries $^2\Sigma^+$, $^2\Pi$, $^2\Delta$ are established and ordered into a consistent scheme. A value of $I(NO, X^2\Pi_{1/2}) = 9.266$ eV is obtained from a Rydberg extrapolation. The non-Rydberg states resulting from configurations $\sigma\pi^2$ and $\pi^3\pi^2$ have all been identified except for a $^2\Phi$ state. In particular, some sharp as well as some recognizable diffuse levels belonging to the state $(\sigma\pi^2)\ ^2\Sigma^+$ have been found in spite of the presence at those energies of the repulsive state $(\sigma 2p)A\ ^2\Sigma^+$ arising from ground state atoms N+O. The numerical results are presented in Tables 1–3. Author

N66-33392*# Rice Univ., Houston, Tex. Dept. of Chemistry.
SUBLIMATION PRESSURES OF REFRACTORY FLUORIDES
R. A. Kent, K. Zmbov, J. D. Mc Donald, G. Besenbruch, T. C. Ehlert et al [1966] 14 p refs
(Grant NsG-6)
(NASA-CR-77001) CFSTI: HC $1.00/MF $0.50 CSCL 07D

Studies of the sublimation of refractory fluorides by Knudsen and/or Langmuir measurements utilizing a semi-microbalance and a mass spectrometer have provided the identities of the vapor species, absolute vapor pressures and heats of sublimation for MgF_2, CaF_2, SrF_2, BaF_2, ScF_3, VF_2, CrF_2, MnF_2, FeF_2, CoF_2, NiF_2, CuF_2, YF_3, CdF_2, LaF_3, CeF_3, DyF_3, HoF_3, and ErF_3. Atomization energies and average bond energies have been calculated. Reduced systems, in which subfluorides are generated, have also been studied. Author

N66-33493*# General Precision, Inc., Little Falls, N. J. Research Center.
HIGH TEMPERATURE STABLE CARBORANE ADHESIVES Second Quarterly Progress Report, Mar. 21–Jun. 20, 1966
Robert Barnes 20 Jun. 1966 28 p refs
(Contract NAS9-5527)
(NASA-CR-65448) CFSTI: HC $2.00/MF $0.50 CSCL 11A

Polymerization characteristics of epoxy materials were evaluated. Epoxybutylcarborane was successfully polymerized in the presence of tris(dimethylaminomethyl)phenol catalyst at a temperature of 85° to 90°C. Under these conditions the liquid epoxy sets to a nonflowing viscous liquid. The polymer is a very brittle solid at room temperature. The reaction of epoxybutylcarborane in the synthesis of carborane-epoxy monomers is described, and 22.4 gm of the epoxy monomer was prepared in five batches. Progress toward the synthesis of several monoalkenyl-carboranes and dialkenylcarboranes is reported. Several batches of carboranes were synthesized to obtain alkenylcarborane intermediates. K.W.

N66-33499*# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Chemical Engineering.
THERMALLY REGENERABLE CARBON DIOXIDE ABSORBENT SYSTEM Final Report, 1 May 1964–31 Jan. 1966
Harry P. Gregor (Leonia, N. J.), Irving F. Miller, and Oscar W. Weber Apr. 1966 252 p refs
(Contract NAS9-2792)
(NASA-CR-65450) CFSTI: HC $3.75/MF $1.50 CSCL 07A

An investigation is presented to determine the feasibility of applying ion exchange resins in gaseous systems. Commercial products and a resin synthesized by cross-linking polyethylenimine with epichlorohydrin are tested. Ion exchange materials are utilized in the solid state; and efforts are directed toward the removal of CO_2 from an air stream by weak-base resins. Unique packed beds were constructed to eliminate channeling; and CO_2 removal from a gas stream was studied at various levels of CO_2 partial pressure, temperature, and relative humidity. A correlation of equilibrium capacity with these variables is obtained. The reaction apparently takes place in four steps, with diffusion within the particles the major rate-controlling step. Diffusion through the surrounding liquid film is also an important contributing factor. The polyethylenimine–epichlorohydrin resin was found to be a good absorbing material for CO_2. It was concluded that CO_2 absorption capacity increases with increasing gaseous partial pressure, increasing water content, and decreasing temperature. S.P.

N66-33511# Coating and Chemical Lab., Aberdeen Proving Ground, Md.
ANALYSIS OF PETROLEUM SOLVENTS BY GAS CHROMATOGRAPHY. PART II: DETERMINATION OF AROMATIC SOLVENTS IN PETROLEUM PAINT THINNERS
George G. Esposito May 1966 18 p refs
(CCL-200; AD-634138) CFSTI: HC $0.50/MF $0.50

The solvency characteristics of petroleum thinners for alkyd resins can be related to the amount of aromatic hydrocarbons present. Many other synthetic resins require thinners of high aromatic content and there is a need for a rapid, accurate analytical method that can be used for quality control. The report describes a procedure for the determination of aromatic solvents in petroleum thinners by gas–liquid chromatography (GLC) using a highly selective partitioning liquid. Author (TAB)

N66-33580# Los Alamos Scientific Lab., N. Mex.
THE SCANDIUM–HYDROGEN SYSTEM
J. F. Stampfer, Jr. 24 May 1966 28 p refs
(Contract W-7405-ENG-36)
(LA-3473) CFSTI: HC $2.00/MF $0.50

A partial phase diagram for the scandium–hydrogen system was determined in the temperature range from 700 to 900°C and compositions ranging from $ScH_{0.4}$ to $ScH_{2.0}$. The equation that relates the hydrogen pressure over the supposed two solid phase region to the temperature was found to be $\log P_{torr} = -[(10.467 \pm 0.552)10^3/T] + 10.527 \pm 0.512)$. In this same region, the heat of formation of the hydrogen-rich phase from one mole of hydrogen and the hydrogen-poor phase was found to be −47.9 kcal/mole of H_2. Both the pressure equation and the heat of formation agree closely with the other recently published data. In the plateau region, the higher temperature isotherms have a definite slope which should not be the case if there are only two components and two phases. Although there is a possibility that the presence of impurities may be the cause of the slope, the evidence is that this is not the case. No other explanation is offered. Author (NSA)

N66-33564# Atomic Energy Commission, New Brunswick, N. J.

BIAS DETERMINATION OF MASS SPECTROMETRIC ISOTOPIC ANALYSIS OF BORON USING PREPARED STANDARDS AND SODIUM AND CESIUM TETRABORATE CHARGE MATERIAL

W. F. King and J. J. Pucilowski, Jr. May 1966 8p refs
(NBL-233) CFSTI: HC $1.00/MF $0.50

Certain differences between New Brunswick Laboratory and other laboratories in isotopic boron analyses were studied. Possible sources of errors in the NBL values were investigated by analyzing the same sodium tetraborate on two mass spectrometers (12-inch, 90° and 6-inch, 60°) for variations between instruments and by analyzing cesium tetraborate made from the same boric acid on the 12-inch, 90° instrument for effects due to different charge materials. Also, synthetic New Brunswick Laboratory standards were analyzed on both instruments for overall accuracy. No significant differences were observed between instruments or charge materials. The greatest deviation from the calculated values of the ratio was 0.10% with a relative 95% C. L. of 0.10% at the 50% boron-10 level and 0.072% with a relative 95% C. L. of 0.093% at the normal level. Author (NSA)

N66-33569# Bureau of Mines, Boulder City, Nev. Metallurgy Research Lab.

ELECTROLYTES FOR ELECTROREFINING HAFNIUM

Morton M. Wong, John M. Hiegel, and G. M. Martinez 1966 18p refs
(BM-RI-6818)

Salt mixtures consisting of KCl, $BaCl_2$, and $HfCl_4$ with RbCl or CsCl were investigated as electrolytes for refining hafnium. The presence of RbCl or CsCl in the electrolyte appeared to suppress the volatility of $HfCl_4$. Best electrorefining was obtained with an electrolyte containing 50.7 percent KCl, 27.1 percent $BaCl_2$, 15.7 percent CsCl, and 6.5 percent $HfCl_4$. In this electrolyte, hafnium metal with an average oxygen content of 470 ppm was produced from an anode feed containing 1,600 ppm oxygen. All metallic impurities were lowered, except titanium, manganese, and tin. Author

N66-33576# Newcastle Univ. (England). Dept. of Inorganic Chemistry.

COORDINATION CHEMISTRY OF GROUP III Final Report

N. N. Greenwood Jan. 1966 5p refs
(Grant AF-EOAR-64-79)
(AFOSR-66-0926; AD-634046) CFSTI: HC $1.00/MF $0.50

A new series of boron–nitrogen heterocyclics of general formula $RR'N_4BH$ were synthesized and their ultraviolet, infrared and Raman spectra studied. Theoretical calculations on the 6-electron π system were compared with experimental results. Proton nuclear magnetic resonance spectra of the following selected compounds were obtained: $Et_2O{\cdot}GaCl_3$, $Et_2O{\cdot}GaBr_3$, $Et_2S{\cdot}GaCl_3$ and $Et_2S{\cdot}GaBr_3$. When analyzed correctly these indicate that $GaCl_3$ is a stronger acceptor than $GaBr_3$ towards these ligands and that Et_2S is a better donor than Et_2O towards the gallium trihalides. Interferrometric techniques have been used with considerable success to determine heavy metal–halogen and metal–ligand vibration and deformation frequencies. Coupled with Raman data this has allowed convincing assignments to be made of the spectra obtained on new compounds. Author (TAB)

N66-33577# Delaware Univ., Newark. Dept. of Physics

ADSORPTION AND DESORPTION OF OXYGEN IN THE ULTRAHIGH VACUUM RANGE AND ITS INFLUENCE ON ELECTRICAL PROPERTIES OF CdS Technical Report No. 7

K. W. Boer [1966] 17p refs
(Contract DA-31-124-ARO(D)-173)
(AROD-4461-8; AD-634032) CFSTI: HC $1.00/MF $0.50

Undoped CdS single crystals are kept in a vacuo of $p < 10^{-9}$ torr. Adsorption of different gases (O_2, H_2, CO_2) was allowed by backfilling the system up to a pressure in the 10^{-5} torr range through a sensitive leak valve; crystal conductance is monitored simultaneously. Changes of the photocurrent up to 3×10^{-6} amperes and sensitivity to changes in the partial pressure of oxygen as small as 10^{-10} torr are reported for different temperatures. Gases are desorbed by a time linear increase of temperature from 80°K to 600°K. The desorption is monitored with a mass spectrometer locked in the investigated mass number. Simultaneous changes of electrical properties are studied using TSC curves. Consequent desorption show, in general, more than one desorption peak, indicating multisite adsorption. Author (TAB)

N66-33587# Naval Research Lab., Washington, D. C.

INTERACTION OF CARBON DIOXIDE WITH HYDROGEN CHEMISORBED ON A PLATINUM ELECTRODE Interim Report

J. Piersma, T. B. Warner, and S. Schuldiner 26 Apr. 1966 14p refs
(NRL-6388; AD-633686) CFSTI: HC $1.00/MF $0.50

The effect of CO_2 on the oxidation of H atoms chemisorbed on a Pt electrode was examined with potentiostatic and transient galvanostatic techniques. The results indicate that CO_2 is not reduced, but that H_{ad} oxidation is inhibited by CO_2, or possibly HCO^-. Under these conditions the inhibited or blocked H_{ad} is stable at potentials negative to 0.300 V (vs N.H.E.). Dissociation of HCOOH to H_{ad} and CO_2 may inhibit the further oxidation of HCOOH by a similar blocking mechanism. Author (TAB)

N66-33601# Dayton Univ., Ohio.

ALLISON METHOD OF CHEMICAL ANALYSIS Final Report, Apr. 1965–Dec. 1966

Herbert F. Mildrum and Bernhard M. Schmidt Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., May 1966 188 p refs
(Contract AF 33(657)-9175)
(UDRI-TR-106; AFAPL-TR-66-52; AD-634008) CFSTI: HC $5.00/MF $1.00

The report describes the theoretical study and experimental circuit investigations conducted on the Allison effect apparatus used for chemical analysis. The inherent electrical behavior of an Allison effect apparatus was well defined by using modern high speed oscillographic techniques and frequency selective equipment. A continuous radio frequency spectrum characterized by numerous resonances rapidly diminishes into the noise level at 4000 megahertz. A theoretical analysis of the apparatus generated a valid equivalent circuit model. A review of the extensive data indicates that the Allison

effect apparatus functions primarily as a phase comparator for radio frequencies in the 30 to 100 megahertz range. An rf–optical interaction in the cells, possibly by means of the Cotton–Mouton effect, is thought to produce a characteristic light modulation effect when phase matching occurs.
Author (TAB)

N66-33607# Institute of Modern Languages, Inc., Washington, D. C.
STRUCTURE OF MATTER: FUNCTIONS OF MOLECULAR DISTRIBUTION AT VARIOUS TEMPERATURES IN A MONOCRYSTAL LIQUID ORIENTED WITH PARA-AZOXYPHENETOL
M. Pierre Delord and M. Jean Falgueirettes Ft. Belvoir, Va., Army Engr. Res. and Develop. Labs., May 1966 8 p refs Transl. into ENGLISH from Compt. Rend. Acad. Sci. (Paris), v. 260, 1 May 1965 p 2468–2471
(Contract DA-44-009-AMC-1563(T))
(ERDL-T-1845-66; AD-632673) CFSTI: HC $1.00/MF $0.50

The radiation diffused by nematic liquid monocrystals was measured by diffractometry. The results obtained give an experimental function G(γ) which is related with the distribution function f(θ) of the axes of the molecules by an integral equation. The function f(θ) was calculated at various temperatures for azoxyphenetol and corresponding degrees of order.
Author (TAB)

N66-33609# Imperial Coll. of Science and Technology, London (England). Nuclear Technology Lab.
RADIATION CHEMISTRY OF ALKYL HALIDES
Christos Capellos (Ph.D. Thesis) Jan. 1965 249 p refs
(Contract AF 61(052)-456)
(ARL-65-157; AD-632704) CFSTI: HC $6.00/MF $1.25

Alkyl iodides and their mixtures were irradiated with Co^{60} gamma rays. Hydrogen iodide and iodine formation was measured as a function of dose for deaerated liquid and solid alkyl iodides and their mixtures. G-values for hydroperoxide formation in aerated alkyl iodides were measured and evidence was found for dialkyl peroxide formation in aerated alkyl iodides. Absorption spectra of the charge transfer complexes IRI formed in the pulse radiolysis of alkyl iodides, were measured and molar extinction coefficients and rate constants for the decay of IRI were obtained. The effect of oxygen and iodine on the formation and constant of decay of IRI was studied. Pulse radiolysis studies of alkyl iodides indicated that the decomposition of solute is larger than that expected on the basis of energy directly absorbed by the solute.
TAB

N66-33622# Callery Chemical Co., Pa.
STUDIES OF COMPLEX PERCHLORATES Final Report
C. R. Guibert, H. F. Klodowski, A. D. McElroy, and M. D. Marshall 1 Jun. 1966 72 p refs
(Contract Nonr-3943(00))
(AD-634105) CFSTI: HC $3.00/MF $0.75

CONTENTS: Raman and infrared spectra of nitronium perchlorate, by J. W. Nebgen, A. D. McElroy, and H. F. Klodowski; Complex light metal perchlorates–tetraperchlorato aluminates, by C. R. Guibert, H. F. Klodowski, M. D. Marshall, and A. D. McElroy; Complex perchlorates–hexaperchloratoaluminates, by C. R. Guibert, J. S. Hashman, H. F. Klodowski, and A. D. McElroy; Complex perchlorates–complexes of boron, beryllium, zinc and titanium, by C. R. Guibert, J. S. Hashman, H. F. Klodowski, and A. D. McElroy; Synthesis of the tetranitratoborate anion, by C. R. Guibert and M. D. Marshall; Appendix: The hexanitratoaluminate.
TAB

N66-33632# Olin Mathieson Chemical Corp., New Haven, Conn. Chemicals Div.
A NEW SERIES OF ORGANOBORANES. VIII: THE REACTION OF PHOSGENE WITH THE DILITHIUM SALTS OF O- AND M-CARBORANE
Joseph R. Reiner, Roy P. Alexander, and Hansjuergen Schroeder Jun. 1966 7 p refs
(Contract Nonr-3395(00))
(TR-31; AD-633890) CFSTI: HC $1.00/MF $0.50

When phosgene was reacted with $O\text{-}B_{10}H_{10}C_2Li_2$ to generate, desired type of compound, the heterocycle-$(O\text{-}B_{10}H_{10}C_2\text{-}CO)_2$ was obtained as a high melting solid (mp.315°) in 50% yield. The carbonyl stretching frequency appeared as a single sharp band at 1720/cm, which indicates a planar ring configuration. In the analogous reaction between $M\text{-}B_{10}H_{10}C_2Li_2$ and phosgene, employment of a large excess of CoCl produced the diacid dichloride, $M\text{-}B_{10}H_{10}C_2(Co.Cl)_2$, which could be expected from this reaction but was obtained in only 20% yield. The other products isolated consisted of a pentane soluble highly viscous material and a pentane insoluble solid, both of which were found to be polymeric (with 3 and 5 repeating units). When equimolar amounts of the two reactants were allowed to interact, only traces of the diacid dichloride were isolated. However, again the polymer having five repeating units proved to be the product with the highest molecular weight.
TAB

N66-33634# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
EXPERIMENTAL DETERMINATION OF THE ROLE OF SOLVENT–SOLVENT ENERGY MIGRATION IN SCINTILLATOR SOLUTIONS AND THE LIFETIME OF THE TRIPLET STATE OF LIQUID BENZENE
James Warren van Loben Sels (M.S. Thesis) Mar. 1966 133 p refs
(GSP/PH66-20; AD-633729) CFSTI: HC $4.00/MF $1.00

Experimental quenching constants were obtained by the spectrophotofluorometric method in aerated and degassed solutions, using benzene, toluene, and p-xylene as donors, and using biacetylas the acceptor. From the quenching constants and the known mean lifetimes of the excited donor states, experimental values for the energy transfer rate constants were determined. It was found that in the undiluted solvent systems, the solvent–solvent energy migration occurred at a rate comparable to that of the material diffusion, and that this rate decreased linearly with solvent dilution. The order of magnitude of the triplet state lifetime of liquid benzene was determined by measurements of the phosphorescence to fluorescence ratio for biacetyl in degassed benzene solution. Comparison of the value for this ratio determined for direct acceptor excitation with the value found for the benzene sensitized acceptor excitation, resulted in the detection of the benzene triplet state and the calculation of its approximate lifetime. This lifetime was found to be of the order 10^{-8} seconds.
Author (TAB)

N66-33638# Rochester Univ., N. Y.
UNIMOLECULAR DECOMPOSITION OF CYCLOBUTANE DERIVATIVES AT HIGH PRESSURE Final Scientific Report
D. J. Wilson and W. D. Walters [1966] 9 p ref
(Grant AF-AFOSR-575-64)
(AFOSR-66-0931; AD-634018) CFSTI: HC $1.00/MF $0.50

Rate constant versus pressure diagrams were obtained for decomposition of ethylcyclobutane diluted with nitrogen at pressure ranges from 305 to 1940 lb/sq in and at 410 ± or −0.1°C. Anomalous behavior of the rate constant was observed, decreasing slightly with increasing pressure. The anomalous effect is explained in terms of transition state

theory where the normal reactant molecules are assumed to be in equilibrium with activated molecules. The volume of activation is calculated to be 35 ml/mole. TAB

N66-33639# Institute of Modern Languages, Inc., Washington, D. C.
THERMAL ANALYSIS OF PICRATES. DEHYDRATION, MELTING POINTS, INITIATING AND PREEXPLOSION TEMPERATURES OF PICRATES OF Al, Sc, Y, La, In AND Tl
T. Tucholsky May 1966 26 p refs Transl. into ENGLISH from Roczniki Chem. (Boznan, Poland), v. 14, 1934 p 430–450
(Contract DA-44-009-AMC-1563(T))
(ERDL-T-1846-66; AD-633414) CFSTI: HC $2.00/MF $0.50

Picrates of scandium, yttrium, lanthanum, gallium, and indium were obtained in the form of various hydrates. The temperatures and conditions of dehydration of picrates of Group III elements were determined; the melting points and preexplosion temperatures were determined. Lanthanum picrate occasionally exploded prematurely at 240°. The data permit the conclusion that groups of elements located under one another in the successive periods of the periodic system produce picrates having a periodically recurring dependence of their initiating temperature T_i on the atomic number of the picrate metal. This dependence is displayed by potassium and calcium metals, in which the highest value of T_i is shown by the picrate of the second element in the series. The minimum deviation from this rule is shown by scandium metal; in picrates of sodium, copper and silver, magnesium, zinc and cadmium and aluminum, gallium and indium. The elements located in the middle of the set of three show the lowest initiating temperatures. A similar behavior may be observed in triazides. TAB

N66-33648# Nottingham Univ. (England). Dept. of Chemistry.
THE KINETICS OF INTERFACIAL TRANSFERS Final Report
D. G. Tuck [1966] 25 p refs
(Grant AF-EOAR-62-53)
(ARL-66-0098; AD-633655) CFSTI: HC $1.00/MF $0.50

The diffusion coefficient across the boundary between Hg_2O_3 and inactive Hg as a function of temperature increased from 1.55×0.01 at 23° C to 1.96±1 at 60.1°C. For iodine, using I^{131} tracer, in aqueous KI, and CCl_4, the diffusion coefficient was 0.875±0.005. For iodine between 0.08 M KI in 0.001 M H_2SO_4 and heptane 34.6±0.3 was found for the diffusion coefficient. Iodine flows across the interface without any slow transfer process being involved whether from the organic to the aqueous phase or from the aqueous to the organic phase. The studies were performed using a 1 mm bore by 30 to 40 cm long vertically mounted borosilicate tube, and thermostated. Movement of the radioactive species was determined by scanning the length of the tube by scintillation counting. Author (TAB)

N66-33656# Eagle-Picher Co., Miami, Okla. Research Labs.
RESEARCH IN PURIFICATION AND SINGLE CRYSTAL GROWTH OF II-VI COMPOUNDS Quarterly Progress Report, 15 Jan.–14 Apr. 1966
R. H. Fahrig, L. W. Brown, and G. N. Webb [1966] 76 p
(Contract AF 33(615)2947)
(QPR-4; AD-634591) CFSTI: HC $2.00/MF $0.50

A study was made of the factors influencing the synthesis purity, and crystallization of group II-VI compound semiconductor materials. Synthesis operations were limited to CdS, ZnSe, and CdTe. A milestone in purity was reached in CdS lot 274 when only 325 parts per billion total impurities were found by mass spectrographic analysis. Purities in general were believed to be somewhat better than usual although this cannot be supported by the emission spectrographic data received. Crystals of CdS, ZnS, CdTe, and ZnSe were grown from the melt. Mixed crystals of CdZnS, ZnSeTe, and ZnCdSe were also grown. Tests of the controller and programmer for the new pressure furnace system were concluded. The units functioned as anticipated and demonstrated that crystals grown using this apparatus are superior in appearance to ones grown by manual control. Also tested was the cover for the new pressure furnace. The successful completion of the tests on this item cleared the way for hardening of the furnace design and proceeding with the construction. The autoclave purchased for the hydrothermal growth of crystals was set up and tested. Crystal growth will be started at once. Author (TAB)

N66-33660# Naval Ordnance Lab., White Oak, Md. Advanced Chemistry Div.
THE DETONATION BEHAVIOR OF HYDRAZINE MONONITRATE
Donna Price, T. P. Liddiard, Jr. and R. D. Drosd 15 Apr. 1966 21 p refs
(NOLTR-66-31; AD-634602) CFSTI: HC $1.00/MF $0.50

Data obtained some time ago on the detonation velocity (D)–loading density (ρ_0)–charge diameter (d) relationships of hydrazine mononitrate were reassessed. They are reported in detail for the first time. The infinite diameter curve is D(mm/microsec)=5.388 (ρ_0)–0.100, where ρ_0 is in g/cc. At finite diameters of 1.27 to 4.14 cm, the D vs ρ_0 curves exhibit maxima. This behavior is to be expected of explosives whose critical diameter increases with increasing loading density, the reverse of the trend exhibited by common explosives such as TNT. Hydrazine mononitrate can therefore be classified as belonging to a group of explosives showing the atypical behavior described. Author (TAB)

N66-33670*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SURFACE PHYSICS AND CHEMISTRY
Robert A. Lad *In its* Selected Technol. for the Petrol. Ind. 1966 p 67–71 (See N66-33666 19-34) GPO: HC $1.25; CFSTI: MF $0.50

Electron paramagnetic resonance (ERP) techniques used to study surface structure and imperfections pertinent to catalysis are described. Experiments on ultraviolet-irradiated magnesium oxide showed that the ferric ion is not the catalytic site. The ERP spectrum of the paramagnetic V_1 center of magnesium oxide was observed and identified, and the lattice structure is discussed. The ERP technique was also used to provide a description of an adsorbed molecule on a surface. Magnesium oxide was irradiated for long periods and then exposed to carbon dioxide, and spectra were obtained and analyzed. It was concluded that the CO_2 molecule changes from the usual linear configuration to the nonlinear form. Work on chemical bonding in refractory compounds and on diffusion in oxides with applications to catalysis are also mentioned. N.E.N.

N66-33681*# National Aeronautics and Space Administration, Washington, D. C.
THE PROBLEM OF THE VOLATILITY OF NIOBIUM OXIDES [A VOPROSU O LETUCHESTI OKISLOV NIOBIYA]
I. V. Golubtsov, A. V. Lapitskiy, and V. K. Shiryayev Jun. 1966 12 p refs Transl. into ENGLISH from Izv. Vyssh. Uchéb. Zaved., Khim. i Khim. Tekhnol. (Moscow), No. 4, 1960 p 571–574 Presented at 1st Interinst. of Higher Learning Conf. on Radiochem., Moscow, 20–25 Apr. 1959
(NASA-TT-F-10224) CFSTI: HC $1.00/MF $0.50 CSCL 07D

Investigations on the volatility of niobium oxides, by measuring the saturated vapor pressure of niobium dioxide and pentoxide, in a Knudsen effusion chamber, from 1489° to 1905°K with radioactive Nb^{95} as tracer, are discussed. Block diagrams of the modified HF-heated vacuum unit with quartz collector, and tabulated data of the measured vapor pressures of niobium oxides are given. Niobium pentoxide in air at 1350°C does not evaporate, while it undergoes thermal dissociation in vacuum above 1150°C in accordance with the equation: $Nb_2O_5 = 2NbO_2 + 1/2\ O_2$. Author

N66-33714*# TRW Systems, Redondo Beach, Calif.

CHEMICAL SPECIES AND CHEMICAL REACTIONS OF IMPORTANCE IN NONEQUILIBRIUM PERFORMANCE CALCULATIONS

P. I. Gold 11 Oct. 1965 41 p refs

(Contract NAS9-4358)

(NASA-CR-65442; TRW-5435-6005-TU-000) CFSTI: HC $2.00/MF $0.50 CSCL 21B

Significant chemical species and reactions in typical propellant exhaust mixtures containing carbon, hydrogen, oxygen, nitrogen, fluorine, chlorine, and one metal element, either aluminum, beryllium, boron, or lithium, were determined for consideration in nonequilibrium performance calculations. The propellant systems were selected as representative of typical liquid rocket cryogenic, space storable and prepackaged storable, hybrid and solid types. Significance of the various propellant systems was established through elimination, by repeated equilibrium and frozen performance calculations. Further reduction was accomplished by studying all possible recombination–dissociation and binary exchange reactions and eliminating those highly improbable. A literature survey to determine the status of rate data for chemical reactions was performed, and the results are included. Data resulting from each step of the study are presented in tabulated form. K.W.

N66-33719*# National Aeronautics and Space Administration, Washington, D. C.

DIFFUSION OF URANIUM IN MOLYBDENUM, NIOBIUM, ZIRCONIUM, AND TITANIUM [DIFFUZIYA URANA V MOLIBDENE, NIOBII, TSIRKONII I TITANE]

L. V. Pavlinov, A. I. Nakonechnikov, and V. N. Bykov Jun. 1966 12 p refs Transl. into ENGLISH from Atomnaya Energ. (Moscow), v. 19, 1965 p 521–523

(NASA-TT-F-10222) CFSTI: HC $1.00/MF $0.50 CSCL 07B

Investigations on diffusion of uranium in molybdenum, niobium, zirconium, and titanium by alpha radiation of U^{235} enriched uranium at 915°–2000°C are reported, with data on the temperature dependence of the diffusion coefficients. The obtained low activation energy of diffusion in zirconium and titanium is attributed to the polymorphous $\alpha \rightleftarrows \beta$ transformation, resulting in atomic defects such as excess vacancies and thus causing a decrease in activation energy and an increase in diffuse mobility. Author

N66-33721*# National Aeronautics and Space Administration, Washington, D. C.

THE VAPOR COMPOSITION IN THE HALIDE SYSTEMS OF CERTAIN ALKALI AND ALKALI EARTH METALS [O SOSTAVE PARA V SISTEMAKH GALOGENIDOV NEKOTORYKH SHCHELOCHNYKH I SHCHELOCHNOZEMEL'NYKH METALLOV]

G. I. Novikov and A. L. Kuz'menko Jun. 1966 17 p refs Transl. into ENGLISH from Vestn. Leningr. Univ., Ser. Fiz. i Khim. (Leningrad), no. 16, 1964 p 143–149

(NASA-TT-F-10195) CFSTI: HC $1.00/MF $0.50 CSCL 07B

Using our previously published data on vapour pressure and condensate analysis in the $KCl–CaCl_2$ and $KCL–SrCl_2$ systems, vapour composition ($KMeCl_3$—form taken into consideration) and equilibrium rate constants of the dissociation process of this compound in the vapour phase and its thermodynamical characteristics have been determined. According to data in the literature, the thermodynamical dissociation characteristics of some binary compounds in the vapour phase have been determined. Author

N66-33722*# National Aeronautics and Space Administration, Washington, D. C.

INVESTIGATIONS OF EFFECT OF INTERSTITIAL IMPURITIES ON THE STRUCTURE AND PROPERTIES OF TUNGSTEN SINGLE CRYSTALS [DASLEDAVANNE UPLYVU PRYMESEY UKARANENNYA NA STRUKTURU I ULASTSIVASTSI MONAKRYSHTALYAU VAL'FRAMU]

Ye. M. Savitskiy and G. L. Tsarev Jun. 1966 20 p refs Transl. into ENGLISH from Vestsi Akad. Navuk Belarusk. SSR, Ser. Fiz-Tekh. Navuk (Minsk), no. 2, 1965 p 84–91

(NASA-TT-F-10157) CFSTI: HC $1.00/MF $0.50 CSCL 11F

The effect of individual interstitial impurities on the structure and properties of tungsten and the identification of the most harmful impurities are discussed, with reference to the low-temperature embrittlement of tungsten and production of high-grade structural materials. Studies on the effect of artificial saturation of tungsten single crystals with carbon, oxygen, and nitrogen showed that carburizing produced a sharp increase in disperse carbides responsible for the rise in carbon content, greater dislocation density leading to inhibition of dislocation migration and thus to microcracks, and higher 25°C yield point. Oxygen saturation did not influence the plastic properties but produced high dislocation density at the grain centers. Nitrogen treatment caused no changes in nitrides on the grain boundaries. Hydrogen had the least influence on embrittlement. Author

N66-33768*# National Aeronautics and Space Administration, Washington, D. C.

ADSORPTION BEHAVIOR OF ORGANIC COMPOUNDS [ZAKONOMERNOSTI ADSORBTSII ORGANICHESKIKH SOYEDINENIY]

B. B. Damaskin Aug. 1966 33 p refs Transl. into ENGLISH from Usp. Khim. (USSR), v. 34, no. 10, 1965 p 1764–1779

(NASA-TT-F-10256) CFSTI: HC $2.00/MF $0.50 CSCL 07C

An adsorption theory of organic compounds is presented which is primarily based on data obtained for a mercury electrode by measuring the σ, ϕ– and C, ϕ-curves. It is found that adsorption on mercury of the majority of organic compounds reducing the double layer capacitance conforms to the isotherm equation of Frumkin. Author

N66-33769*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

SURFACE ADSORPTION IN MAGNESIUM OXIDE

T. H. Nielsen and M. H. Leipold 1 Jun. 1966 23 p refs

(Contract NAS7-100)

(NASA-CR-77117; JPL-TR-32-949) CFSTI: HC $1.00/MF $0.50 CSCL 07B

Calculations are presented for approximating the adsorption energies of argon and helium atoms, and hydroxyl ions on magnesium oxide (MgO) surfaces, with consideration being given to abnormal, highly active sites. Results indicate extremely high (>100 kcal/mole) adsorption energies for these species (in certain active sites) that are unlikely to be removed in thermal treatment. The number of such active sites is calculated, the ease of determination of impurities located in such active sites is evaluated, and methods of reducing

such contamination by adsorption are discussed. Findings indicate that rearrangement of surface structure is unlikely in MgO and that adsorption of gas is the most likely mechanism by which MgO can lower its surface free energy. Author

N66-33806# Florida Univ., Gainesville. Dept. of Chemistry.
RESEARCH ON SYNTHESIS OF UNSATURATED FLUOROCARBON COMPOUNDS Semiannual Report, Oct. 1, 1965–Mar. 31, 1966
Paul Tarrant, Doug Perry, Jai Tandon, Alan Wright, and Susumu Misaki [1966] 55 p refs
(Contract DA-19-129-AMC-79(N))
(SAR-6; AD-634116) CFSTI: HC $3.00/MF $0.50

Work has continued on some aluminum chloride catalyzed additions of polyhaloalkanes to haloolefins. Additional work has been done using perfluoroallyl systems. Nitrosyl chloride has been allowed to react with some fluorodienes to give a nitroso derivative in one case (but to give a suspected Diels–Alder adduct when the diene was conjucated). Free radical additions of haloalkanes to various olefins have been attempted and in some cases reactions of the products investigated. The free radical addition of haloalkanes to aromatic nuclei has been continued and terminated. Some Diels–Alder additions between cyclopentadiene and some haloolefins has been effected, and the preparation of some fluoronorbornadienes from the products has been attempted. Author (TAB)

N66-33831# Pennsylvania Univ., Philadelphia. Dept. of Chemistry.
SOLVENT ISOTOPE EFFECTS FOR CH_3OH vs. CD_3OH Final Report, Jun. 1963–May 1966
Edward R. Thornton [1966] 9 p ref
(Grant AF-AFOSR-431-63)
(AFOSR-66-0915; AD-634107) CFSTI: HC $1.00/MF $0.50

A precise (hopefully approaching ±0.1%) method of determining solvent isotope effects for competitive methanolysis reactions of alkyl halides (and other compounds) in mixtures of methanol (CH_3OH) and methan-d_3-ol (CH_3OH) is being developed. The method utilizes gas chromatographic separation of very small amounts of reaction product followed by mass spectrometric analysis of the isotopic ratios in the product. Careful control experiments are necessary to insure accuracy and high precision. The results are expected to provide detailed information about the activation process for solvolysis reactions. Author (TAB)

N66-33848# Spined (Paolo), Rome (Italy).
RESEARCH INTO THE CHEMICAL BEHAVIOR OF SURFACES OF SINGLE-CRYSTALS, BI-CRYSTALS, AND TRI-CRYSTALS UNDER DIFFERENT EXPERIMENTAL CONDITIONS
Paolo Spinedi Mar. 1966 10 p refs
(Contract DA-91-591-EUC-3593)
(AD-633764) CFSTI: HC $1.00/MF $0.50

Information is given about the results obtained, by the use of an emission microscope, in the field of oxidation studies and of controlled reduction processes, carried out both on organic nuclei (previously deposited from vapor phase on a suitable metallic substratum), and on hematite natural crystals. New results are summarized concerning the electrochemical behavior of zinc tri-crystals under potentiostatically controlled conditions. A brief account is given of some preliminary tests regarding liquid metal penetration along the grain boundaries of a zinc tri-crystal substratum. TAB

N66-33883# Brandeis Univ., Waltham, Mass.
PHOTOCHEMISTRY OF AZO COMPOUND AND STUDIES IN UNIMOLECULAR REACTIONS Final Scientific Report, 1 Jan. 1964–31 Dec. 1965
Colin Steel [1966] 34 p refs
(Grant AF-AFOSR-583-64)
(AFOSR-66-0930; AD-633969) CFSTI: HC $2.00/MF $0.50

Photochemical production of hot molecules; pressure dependence investigation during photolysis of 2,3-diazabicyclo (2,2,1)-2-heptane (DBH) showed that although the incident radiation may be monochromatic, the mechanism of dissociation is such as to result in energy dispersion with the result that the vibrationally hot molecules produced are by no means monoenergetic. Primary processes in the photochemistry of cyclic azo compounds: fluoreseence emission was observed in both DBH and 2,3-diazabicyclo (2,2,-2)-2-octene (DBO). The gas-phase spectra for DBH showed that the excitation spectrum closely parallels the adsorption spectrum and that emission spectrum is a good qualitative mirror of the latter. DBO spectra were similar to those of DBH but the clear mirror image relationship observed for DBH was lost. Energy transfer: various substances, including CO_2 are being studied regarding their efficiency as energy transfer agents in the gas phase photolysis of DBH into vibrationally excited compounds. Author (TAB)

N66-33866# Brookhaven National Lab., Upton, N. Y.
INVESTIGATIONS AND APPLICATIONS OF THE CHEMICAL EFFECTS OF NUCLEAR TRANSFORMATIONS. I. TELLURIUM ISOMER GENERATORS
Manny Hillman and Allen J. Weiss 28 Apr. 1966 25 p refs
(Contract AT(30-2)Gen-8)
(BNL-10182) CFSTI: HC $2.00/MF $0.50

The possibility of preparing an isomer generator based on the chemical and nuclear transformations of ^{129g}Te(IV) yields from ^{129g}Te(VI) was investigated. The ion exchange behavior of Te(VI) on alumina was also studied. The results showed that Te(IV) can be adsorbed on alumina between pH 0 and 10 and can be eluted in greater than 95% yield by a solution, the pH of which lies outside this range. Alumina was used to prepare isomer generators in which the ^{129g}Te was allowed to grow in at various pH's. The milking yields obtained are listed. NSA

N66-33872# Commissariat a l'Energie Atomique, Fontenay-Aux-Roses (France). Centre d'Etudes Nucleaires.
REACTION OF URANIUM AND PLUTONIUM CARBIDES WITH NITROGEN [REACTION AVEC L'AZOTE DES CARBURES D'URANIUM ET DE PLUTONIUM]
Robert Lorenzelli, Andre Martin, and Roger Schickel Mar. 1966 28 p In FRENCH
(CEA-R-2997)

Uranium and plutonium carbides reacted with nitrogen during the grinding process preceding the final sintering. The reaction occurred even in argon atmospheres containing a few percent of residual nitrogen. The resulting contamination was responsible for the appearance of an equivalent quantity of higher carbide in the sintered products; nitrogen remained quantitatively in the monocarbide phase. UC can be transformed completely into nitride under a nitrogen pressure, at a temperature as low as 400°C. The reaction is more sluggish with PuC. The reactions that take place are: $UC+0.5N_2 \rightarrow UN_{1.50}+C$; $PuC+0.5\ N \rightarrow PuN+C$. Author (NSA)

N66-33884# Columbia Univ., New York. Radiation Chemistry Research Group.
THE EFFECTS OF RADIATION ON THE CHEMICAL ACTIVITY OF CERTAIN SOLID OXIDE CATALYSTS Progress Report, 1 Apr.–31 Dec. 1965

[1965] 21 p refs Submitted for Publication
(Contract AT(30-1)-2791)
(CU-2791-5) CFSTI: HC $1.00/MF $0.50

Studies of hydrogen–deuterium exchange on alumina showed that radiation definitely enhanced the activity of this catalyst. The effects of radiation decreased with increasing temperature with a negative activation energy of 5 to 7 kcal/mole. Measurement of the activation energy for removal of sites, made by following the rate of decay in activity after irradiation was stopped, gave a value between 3 and 6 kcal/mole. A reasonable explanation for these results is that radiation forms trapped electrons or holes, upon which the exchange reaction takes place with little, if any, activitaion energy. Release of these trapped electrons or holes may have an activation energy of around 6 kcal/mole. The results demonstrated the value of *in situ* measurements because the life-time of the active sites was too short at 50 to 150° to be analyzed solely by post-irradiation measurements. Contrary to previous results, additional tests on zinc oxide showed no effects from irradiation. NSA

N66-33887# Wisconsin Univ., Madison. Dept. of Chemistry.
DIFFUSION IN ZEOLITES AND GLASSES Technical Progress Report
Werner W. Brandt Mar. 1966 15 p refs
(Contract AT(11-1)-1550)
(TID-22966) CFSTI: HC $1.00/MF $0.50

X-ray diffraction measurements were made on several lithia-borates and lead borates. Preliminary results showed a stong tendency to crystallization in both composition series only near 0 and 100 mole % lithia, or lead oxide content. Also, preliminary results on etching to determine if phase separations occur in the glasses of interest were negative. However studies along this line will be continued. NSA

N66-33897# Stanford Research Inst., Menlo Park, Calif.
[CHEMISTRY OF MOLTEN SALTS AND METAL–SALT SOLUTIONS AT ELEVATED TEMPERATURES] Ten-Year Summary of Accomplishments
Daniel Cubicciotti 6 Apr. 1966 24 p refs *Its* Tech. Rept.-43
(Contract AT(04-3)-106)
(SRIA-106-38) CFSTI: HC $1.00/MF $0.50

Research is summarized on metal–salt phase diagrams, activities in metal–salt solutions, metal–salt volumes of mixing, and electrolysis of Bi–$BiCl_3$ mixtures. Information is included concerning the chemistry of divalent halides and thallous halides. Research progress is also summarized on molten-salt enthalpies and entropies, and vaporization of salts at pressures below one atmosphere. Brief summaries are included on energies of alkaline earth halides, transpiration of $ZnCl_2$, enthalpy of thallous fluoride, and methods for vapor pressure data analysis. NSA

N66-33933# Kansas Univ., Lawrence. Dept. of Chemistry.
RADIOLYSIS STUDIES ON FLUOROCARBONS AND ON REACTIVE INTERMEDIATES Technical Progress Report, 1 Sep. 1965–31 Aug. 1966
Larry Kevan 16 May 1966 30 p refs
(Contract AT(11-1)-1528)
(COO-1528-5) CFSTI: HC $2.00/MF $0.50

The results of studies on paramagnetic relaxation of trapped electrons in alkaline ices and fluorocarbon radiolysis are reported. A brief abstract on electron and excited water reactions in nitrate ices is also included. Results in aqueous and in frozen solutions showed very close parallels and strongly implied that the same radioinduced intermediates are formed and react similarly in both phases. Studies on NaOH showed that the F-center model of the electron trapped in a hydroxyl ion vacancy remains consistent with the relaxation studies although the particular spin-lattice relaxation mechanisms of electrons in KCl and in ice differed. The dominant spin-lattice relaxation mechanism for the electron in ice probably involves cross relaxation with an O^- radical ion. It was concluded that spin–spin interactions take place between spins within a spur and therefore that the anion vacancy is located within a spur in the irradiated ice. From radiolysis studies on C_2F_6, C_3F_8, and C_4F_{10}, it was concluded that the predominance of C–C bond breaking over C–F bond breaking is a general characteristic of perfluoroalkane radiolysis. The most probable excitation energy for radiolytic intermediate in nonpolar systems is believed to be between 20 and 35 kcal. NSA

N66-33934# Isochem. Inc., Richland, Wash.
SPECTROGRAPHIC ANALYSIS OF THORIUM AND URANIUM FOR THE RARE EARTH ELEMENTS
N. S. Wing 21 Apr. 1966 10 p refs
(Contract AT(45-1)-1851)
(ISO-SA-13) CFSTI: HC $1.00/MF $0.50

A spectrographic method that permits the determination of rare earth impurities at the 1 ppM level is described. Tributyl phosphate was selected to separate the rare earths from the matrix material extractions made from 6 M HNO_3 solutions gave very good separation of the rare earths. Results obtained on analysis of 8 thorium and 10 uranium samples agreed very well with the known value. NSA

N66-33935# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
ELECTRON MICROPROBE ANALYSIS OF PLUTONIUM–GALLIUM ALLOYS
M. R. Harvey and D. H. Riefenberg 16 May 1966 11 p refs Presented at AEC Ann. Metallography Meeting, Denver, 18–20 May 1966
(Contract AT(29-1)-1106)
(RFP-765; CONF-660518-1) CFSTI: HC $1.00/MF $0.50

A calibration curve of relative intensity versus gallium concentration was obtained on a series of plutonium–gallium alloys. The concentration range studied was 0.56 to 2.12 wt %. The relative intensity was found to vary linearly with concentration in this range. Based on the standard deviations observed in this work, 19 determinations were required for an accuracy of ±0.05 wt % absolute at a confidence level of 99%. Author (NSA)

N66-33936# Brookhaven National Lab., Upton, N. Y.
INVESTIGATIONS AND APPLICATIONS OF THE CHEMICAL EFFECTS OF NUCLEAR TRANSFORMATIONS. II: THE SZILARD–CHALMERS PROCESS IN METALLOPHTHALOCYANINES
Manny Hillman and Allen J. Weiss 11 May 1966 19 p refs Presented at the 7th Japanese Conf. on Radioisotopes, Tokyo
(Contract AT(30-2)-GEN-16)
(CONF-660503-2; BNL-10208) CFSTI: HC $1.00/MF $0.50

Investigations on the Szilard–Chalmers process in Zr and Hf phthalocyanine are described. Irradiations were carried out for 10 min in a pneumatic tube facility at fluxes approximately 10^{13} n cm^{-2} sec^{-1}. Separation of recoil atoms from parent compounds was accomplished by dissolution of the metallophthalocyanine in DMSO followed by reprecipitation by filtration through 0.45 μm Millipore filter paper. Enrichment factors and retentions for the individual isotopes was accomplished by means of gamma spectrometry. Isotope effects observed in the reactions are discussed. NSA

N66-33937# Los Alamos Scientific Lab., N. Mex.
DISSOCIATION OF NIOBIUM PENTACHLORIDE ON NIOBIUM AND CARBIDE SURFACES

V. P. Eliutin, G. I. Pepekin and B. S. Lysov [1966] 11 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zaveoenii, Tsvet. Met., (Dzaudzhikau), v. 8, no. 4, 1965 p 90–96
(LA-TR-66-15) CFSTI: HC $1.00/MF $0.50

Studies on the kinetic principles of the process of niobium pentachloride dissociation on a niobium surface with the formation of the metal were used to determine the mechanism of niobium carbide formation. The deposition of Nb and NbC from the pentachloride was carried out in a helium stream. Niobium carbide deposition on a graphite base was fulfilled at low concentrations of $NbCl_5$ in the vapor gas phase (less than 6×10^{-2} atm) and the comparatively low temperatures of 1500–1800°K, near the temperature for the onset of the formation of NbC. The dependence of the rate of $NbCl_5$ decomposition to Nb and NbC on the partial pressure of $NbCl_5$ in the vapor gas phase is described by the empirical equations, respectively, $W=KP^{0.7}$ and $W=K_2P^{0.8}$. It was concluded that during the decomposition of $NbCl_5$ in the presence of C even under conditions thermodynamically unfavorable for the deposition of Nb, the functions of C consists only of the carbiding of the Nb metal being formed in the process of the thermal dissociation of $NbCl_5$. NSA

N66-33943# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.

U.S.-EURATOM RESEARCH AND DEVELOPMENT PROGRAM. Final Summary Report

D. L. Douglass Oct. 1965 87 p refs
(Contract AT(04-3)-189)
(GEAP-5001; EURAEC-1588) CFSTI: HC $3.00/MF $0.75

Transmission electron microscopy of the corrosion–oxidation films on Van Arkel Zr and Zircaloy-2, formed in air from 250° to 450°C and in water from 225° to 325°C, showed that gross differences existed in the film morphology depending upon the environment and surface preparation. Annealed Zr when oxidized in air formed monoclinic zirconia films that replicated the metal grain structure, but which also contained fine-grain regions, pseudo–amorphous areas, pustules, and preferentially oxidized grain boundaries. Etched Zr, oxidized under the same conditions, formed uniform films having only one heterogeneity, preferentially oxidized twins. Oxidation of annealed Zr in water produced a high density of oxide nuclei (monoclinic oxide) on a single crystal monoclinic matrix. Longer oxidation produced pustules that were much more numerous than those formed by air oxidation. Some pseudo–amorphous areas were also observed, but the pustules appeared more important, and grew laterally to form a completely coalesced overgrowth. Zircaloy-2 generally formed more uniform films than Zr in air and in water, and did not exhibit the preferential grain boundary oxidation so prevalent in Zr oxidation films. Annealed Zircaloy-2 formed mottled films, whereas, etched Zircaloy-2 similarly oxidized, showed unmottled grains that were sharply delineated and which clearly showed local areas corresponding to the intermetallics. The intermetallic compounds, which were selectively etched in the metal, gave rise to small white islands in the oxide films. These areas were found by electron diffraction to be nearly structureless. Transmission electron microscopy of detached oxidation films on Ti showed that thin films of rutile formed initially of uniform thickness and replicated the metal structure. The replicated metal grains, hereafter called oxide grains, were either polycrystalline on thermally etched facets of the metal, or were pseudo-monocrystalline and consisted of low angle boundaries and subgrains. Subsequently, an overgrowth of rutile nucleated on the oxide grains. The overgrowth of single-crystalline, heavily microtwinned oxide, grew laterally and enclosed islands of matrix oxide, as well as inwardly, and consumed the initial film. Complete coalescence resulted in single crystal oxide grains corresponding to each metal grain. Two networks could be distinguished by contrast variations upon tilting. The first, which was most prevalent, nucleated within the oxide grains and only rarely crossed grain boundaries, whereas, the second nucleated at grain boundaries and grew across the grains. Oriented networks formed on faceted grains and grew along the faces rather than crossing ridges. Random networks were generally associated with pseudo-monocrystalline grains which formed on unfaceted metal grains. The characteristics of the matrix and the networks during heating are discussed, and the role of time and temperature on network nucleation and growth is considered. A few data points for oxygen–ion self-diffusion in UO_2 single crystals were obtained from 850 to 1000°C, but because of experimental difficulties, the reliability of the data is questionable. Author (NSA)

N66-33944# Atomic Energy of Canada, Ltd., Chalk River (Ontario).

X-RAY SPECTROGRAPHIC DETERMINATION OF SOME METAL OXIDE ADDITIVES IN UO_2 AND ThO_2

L. W. Wray Dec. 1965 10 p refs
(AECL-2526; CRDC-1230) Available from Atomic Energy of Canada, Ltd., Chalk River: $0.50

Methods of analysis are described for La, Nb, Th, Ti, and Zr additives in UO_2, and for U and Y additives in ThO_2, present in the concentration range 0.05–1.0%. Th, Y, or Zr in UO_2, and U or Y in ThO_2 were determined directly in the oxide mixture. A suitable analytical line of the matrix element was used as an internal standard. Limits of detection were between 0.006 and 0.01% for these additives. For La, Ti, or Nb in UO_2, the oxide was dissolved in HNO_3 and the uranium removed by organic solvent extraction. La and Ti were determined in aqueous solution. The limit of detection was about 0.002%. Nb was precipitated in the presence of cellulose and briquetted. The limit of detection was 0.0005%. Author (NSA)

N66-33947# United Kingdom Atomic Energy Authority, Harwell (England).

THE DETERMINATION OF OXYGEN IN URANIUM NITRIDE BY INERT GAS FUSION

B. L. Taylor, H. A. Prior, B. S. Perrett, and P. Bird Apr. 1966 15 p refs
(AERE-R-5190) HMSO: 2s 6d

An inert gas fusion apparatus for the determination of oxygen in uranium nitride is described. The sample is reacted with carbon in a high-temperature graphite resistance furnace and the carbon monoxide removed in a stream of high-purity helium. After oxidation of the carbon monoxide to carbon dioxide, the latter is frozen out in a multi-loop trap and finally measured in an open-well capillary manometer. A gas injection valve is used for test purposes. As an initial check on the method it was applied with success to oxygen determinations in various standard materials other than nitrides. When applied to uranium nitride the method gave results that appear to be completely satisfactory. Author (NSA)

N66-33951# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

THE RADIOLYSIS OF A MIXTURE OF CARBON DIOXIDE AND HYDROGEN

G. L. Tingey Apr. 1966 17 p refs Presented at the Libby Cockcroft Meeting on Graphite Chem., Harwell, England
(Contract AT(45-1)-1830)
(BNWL-SA-591; CONF-660409-2)

The γ radiolysis of CO_2 and H_2 was investigated. Initially, CO and H_2O vapor were formed in equal quantities along with small quantities of CH_4. As the reaction progressed the rate of CO formation decreased rapidly with a much smaller decrease in the rate of H_2O formation. An orange solid, with empirical formula $C_2H_3O_{1.1}$, was also formed in the reaction. The yield

of CO and H_2O, over the temperature range from 100 to 400°C, is given by $G(CO) = G(H_2O) = 17.3\ e^{-1.700/RT}$ molecules/100 ev. The yield of CH_4 was 0.3 molecules/100 ev at 100°C and decreased as the temperature increased. Variations in relative concentrations of the reactants showed that the activated species from $H_2(H_2^+$ or H) contribute only to methane formation with little or no effect on the formation of CO and H_2O. Author

N66-33990# Academia R. P. R., Bucharest (Romania). Institutul de Fizica Atomica.

PARAMAGNETIC CENTERS FORMED BY IRRADIATION IN THE OXYGENATED COMPOUNDS OF SELENIUM. II: E.S.R. SPECTRA OF POLYCRYSTALLINE IRRADIATED $SeO_4(NH_4)_2$

M. Constantinescu, O. Constantinescu, I. Pascaru, and E. Gird 21 Dec. 1965 16 p refs

(NP-16037)

The effects of gamma and neutron irradiation on polycrystalline $SeO_4(NH_4)_2$ were studied by ESR and radiochemical methods. From the ESR spectra and from the behavior on heating, NH_4^+ and O_2^- radicals as well as radicals from selenium which can be of SeO_4^-, SeO_3^- or SeO_2^- type, were observed. A mechanism of formation for these species is suggested. The dependence of paramagnetic center concentration on the integral dose was also studied. Author (NSA)

N66-33998# Argonne National Lab., Ill.

ELECTRODE KINETICS

John P. Elder Jul. 1965 68 p refs

(Contract W-31-109-ENG-38)

(ANL-7072) CFSTI: HC $3.00/MF $0.75

A discussion is presented on the fundamental tenets of electrode kinetics and the methods whereby the characteristic parameters of rapid-charge transfer processes at electrode-electrolyte interfaces are evaluated. Purposely, electroanalytical methods, which have resulted from techniques originally aimed at elucidating electrode mechanisms, such as polarography and its many ramifications, were not discussed. NSA

N66-34009# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.

SYNTHESIS AND CHARACTERIZATION OF A SERIES OF ORGANOPHOSPHOROUS-NITROGEN POLYMERS

R. M. Washburn and D. W. Karle [1966] 15 p refs Presented at the Soc. of the Plastics Industry Western Regional Conf., Palm Springs, Calif., 30 Mar. 1966

(Douglas Paper-3803)

The synthesis and physical properties of a series of 1,3,2,4-diazadiphosphetidines is described. A new transamidative reaction between arylenediamines and hexaalkylphosphoramides to produce polymers of alternating diazadiphosphetidine and arylene units is reported. The diamines which have been used for the preparation of polymers are p-phenylenediamine, m-phenylenediamine, oxydianiline, 4,4'-methylenedianiline, methylene-bis-o-chloroaniline, 4,4'-sulfonyldianiline and 2,4-toluenediamine. The preparative methods and physical properties (infrared absorption spectra, solubility, and thermal characteristics) of the polymers are discussed. The polymer derived from 4,4'-methylenedianiline has been subjected to an isothermal cure study and has been used to prepare laminates. The polymers appear to be thermoplastic up to about 350°C and undergo conversion to thermoset materials above about 375°C. Author

N66-34011# Institute of Modern Languages, Inc., Washington, D. C.

NEW SALTS OF FULMINIC ACID

Lothar Wohler, Al Weber, and A. Berthman Ft. Belvoir, Va., Army Engr. Res. and Develop. Lab., Apr. 1966 28 p refs Transl. into ENGLISH from Chem. Ber. (Weinheim), v. 62, 1929 p 2742-2758

(Contract DA-44-009-AMC-156(T))

(ERDL-T-1826-66; AD-633399) CFSTI: HC $2.00/MF $0.50

Descriptions are given of the preparation and properties of the following: fulminates of sodium, potassium, calcium, strontium, and barium. Complex fulminates of silver with ammonia and with magnesium. Complex pyridine fulminates with zinc, copper, silver, cadmium, mercury, and lead. Double salts of mercury fulminate with sodium thiosulfate, potassium bromide, and the chlorides of sodium, calcium, and magnesium. Complexes of ammonia with zinc and manganese fulminates. Complex salts of sodium and nickel fulminate, potassium and cobalt (III) fulminate, sodium-platinum (II) fulminate, calcium-strontium and barium-platinum (II) fulminates, sodium-aurofulminate, sodium-palladium (II) fulminate. The cuprofulminates of sodium, strontium, calcium, and barium. The cupric-di-cuprofulminate. TAB

N66-34038# Royal Aircraft Establishment, Farnborough (England).

FLUOROMATIC POLYMERS, PERFLUORO-METAPOLYPHENYLENES

J. Thrower and Mary A. White Feb. 1966 27 p refs

(RAE-TR-66031) CFSTI: HC $2.00/MF $0.50

The Ullmann reaction in dimethylformamide has proved very successful for the synthesis of perfluoro-*meta*-polyphenylenes. Properties of model compounds and polymers described include general physical characteristics as well as thermal and thermal oxidative stability. Infrared, ultraviolet and mass spectra are briefly discussed. Author

N66-34057# Office of Naval Intelligence, Washington, D. C. Translation Section.

KINETICS OF THE ELECTROCHEMICAL REDUCTION OF OXYGEN [KINETIKA ELEKTROCHIMICHESKOVA BOSSTANOVLENIYA KISLORODA]

T. N. Belina and A. I. Krasil'shchikov [1966] 10 p refs Transl. into ENGLISH from Zh. Fiz. Khim. (Moscow), v. 28, no. 7, 1954 p 1286-1291

(ONI-TRANS-2149; 77-66-61573; AD-634598) CFSTI: HC $1.10/MF $0.50

It was confirmed that cathode reduction of oxygen in alkaline solutions on silver, unlike mercury, is connected with electrochemical polarization. The cathode reduction of oxygen was investigated at different pressures in acid and alkaline solutions on smooth and platinized platinum and palladium. The reduction of oxygen on platinum is limited by the purely chemical stage of the process. Author (TAB)

N66-34060# Marine Engineering Lab., Annapolis, Md.

THE BEHAVIOR OF SUPERALLOY OXIDE FILMS IN MOLTEN SALTS

W. L. Wheatfall, H. Doering, and G. J. Daner, Jr. Jul. 1966 32 p refs

(MEL-278/66; AD-634183) CFSTI: HC $2.00/MF $0.50

The effect of molten salts on the behavior at 1650°F of oxide films on two nickel-base superalloys and pure nickel was investigated. In the initial experiments, Na_2SO_4 and NaCl were reacted with Cr_2O_3 and NiO in both oxidizing and reducing atmospheres. Reactions occurred only under reducing conditions. Half-cell potential as a function or time was measured to study the effects of oxide thickness, electrolyte composition

and atmosphere. A sustained rise in half-cell potential always accompanied sulfidation. In alloy A (AMS 5391A) scale formation occurred at the metal-scale interface and Na_2SO_4–5 w/o NaCl was more corrosive than Na_2SO_4 alone, sulfidation in alloy B (AMS 5384) occurred only when NaCl was present. On both alloys A and B the thicker the oxide film, the longer the elapsed time to a sustained rise in half cell potential.

Author (TAB)

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N66-32761*# Kansas Univ., Lawrence. Engineering Science Div.

RADAR AS A REMOTE SENSOR

R. K. Moore 13 Jan. 1966 56 p refs

(Contract NSR-17-004-003)

(NASA-CR-76890; CRES-61-7) CFSTI: HC $2.50/MF $0.50 CSCL 17I

Radar is a self-illuminating sensor operating over a wide wavelength range, but especially in the microwave region. Because of control over illumination, techniques not available to passive sensors can be used to measure range, azimuth, and radial velocity. These techniques are described. Radar return is determined by many parameters, especially wavelength, roughness, and dielectric properties. Fundamental techniques used in theoretical descriptions of the scattering process are described briefly. Experiments have indicated radar return is influenced near the vertical by relatively flat parts of the surface and near the horizontal by surface elements with smaller radii, but numerous additional measurements are needed to describe radar return from natural surfaces and to relate to theory.

Author

N66-32942*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ATMOSPHERIC TRACKING ERRORS AT S-BAND AND C-BAND FREQUENCIES

P. E. Schmid Washington, NASA, Aug. 1966 36 p refs

(NASA-TN-D-3470) CFSTI: HC $2.00/MF $0.50 CSCL 17B

The primary purpose of this paper is to provide a realistic estimate of the errors introduced in microwave ranging measurements as a result of diurnal, seasonal, and annual changes in the earth's atmosphere. This analysis, which is based upon the extensive atmospheric investigations described in the literature, is directly applicable to such systems as the unified S-band system which will be employed in the forthcoming Apollo missions. The effects of both the troposphere and ionosphere upon measurements of range, range-rate, and elevation angle are discussed.

Author

N66-33013*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

TELEMETRY PROCESSING FOR NASA SCIENTIFIC SATELLITES

Edmund J. Habib, Frank A. Keipert, and Richard C. Lee Washington, NASA, Aug. 1966 17 p refs

(NASA-TN-D-3411) CFSTI: HC $1.00/MF $0.50 CSCL 09F

More than 10^8 data points per day will be received from NASA scientific satellites. This paper gives a description of the techniques now in use and shortly to be used at GSFC to process this large volume of telemetry data. It also discusses attendant problems and possible future plans for coping with this explosion from the analysis viewpoint.

Author

N66-33037# Council for Scientific and Industrial Research, Johannesburg (South Africa). National Inst. for Telecommunications Research.

[RADIO WAVE PROPAGATION AND SATELLITE TRACKING] Annual Special Report, 1964–1965

1965 25 p refs

(TEL-53) CFSTI: HC $1.00/MF $0.50

Research activities are reported in the form of summaries on radio wave propagation in the ionosphere; radio noise levels below 30 Mc/s; radar echoes from precipitation; advanced radio techniques for distance measurement; and microwave power sources, position fixing, and parametric amplifiers. Radio and space research includes summaries of operations and mobile tracking stations of the deep space instrumentation facility, and activities of the satellite tracking and data acquisition facility. A short article reports development in radio astronomy.

K.W.

N66-33040# Radio and Space Research Station, Slough (England).

KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY THE SATELLITE ORBITS GROUPS FROM MALTA FOR MARCH AND APRIL 1966

[1966] 32 p *Its* Issue No. 14

CFSTI: HC $2.00/MF $0.50

Satellite observation data are tabulated for the Transit 2A, Midas 4 and 7, Thor Agena D, Explorer 17 and 19, Dash 2, Echo 2, Ablestar, Cosmos 58 and 61, Pegasus 2, Apollo 4, Thor Altair, Altair, Alouette 2, and Cosmos 108.

M.G.J.

N66-33041# Radio and Space Research Station, Slough (England).

KINETHEODOLITE OBSERVATIONS OF SATELLITES RECEIVED BY THE SATELLITE ORBITS GROUP FROM MALTA FOR MARCH 1966

[1966] 27 p *Its* Issue No. 13

CFSTI: HC $2.00/MF $0.50

Satellite observations are listed for the Courier 1B, Midas 4, Ariel 1 and 2 rockets, Centaur 2, Ablestar, Echo 2, the Cosmos 44, 53, and 71 satellites, Agena D, Altair, Alouette 2, and the Explorer 22 and 23.

M.G.J.

N66-33143# Texas Univ., Austin. Antennas and Propagation Lab.

QUANTITATIVE OBSERVATIONS OF DOT ANGEL ECHOES AT TWO FREQUENCIES

Andrew P. Deam and Alfred H. La Grone 10 Jul. 1965 24 p refs

(Grant NSF GP-2596)

(NSF-P-2)

Results of many observations of clear air dot angel type echoes are reported. Measurements were made at two wavelengths, $\lambda = 2.2$ cm and $\lambda = 9.1$ cm, using nearly identical antenna beams pointed vertically. Simultaneous measurements, made at the two frequencies, are reported. Results suggest particulate matter, probably insects, as the source of most clear air dot angel echoes. Other clear air angel type echoes were observed on rare occasions which are believed to originate at inversion layers. They were received only on S-band and did not exhibit the same characteristics as most dot angel type echoes.

Author

N66-33147# Electronic Associates, Inc., Long Branch, N. J.
VOICE ACTUATED ADDRESS MECHANISM Quarterly Progress Report, 1 Jun.–31 Aug. 1965
Donald Fraipont Dec. 1965 36 p
(Contract DA-28-043-AMC-01223(E))
(QPR-2; AD-625730) CFSTI: HC $2.00/MF $0.50

Most of the work was related to investigations leading to: (1) The improvement of preprocessing techniques; (2) The improvement of the efficiency of learning. Included is the program extending the learning capability to include mass storage of a large set of training voices. The program is an automated learning program and a minimum of operator intervention is required. Several programs designed to test voiced words for ease of separation were written, debugged, and applied to VAAM's vocabulary. A filter correlation program was evaluated. Two other programs were used to search for elements of the digital voicings which would yield an indication of the separability of VAAM's vocabulary. Author

N66-33150# TRG, Inc., Menlo Park, Calif.
OPTIMIZED FEEDS FOR THE WIRE-GRID LENS HF ANTENNA AT THE FAA RECEIVER STATION, MOLOKAI, HAWAII Final Report
F. B. Harris, Jr., R. L. Tanner, and E. M. T. Jones Dec. 1965 69 p refs
(Contract FAA-ARDS-598)
(RD-65-128; PB-169179) CFSTI: $3.00

Development and testing of optimized feeds for a wire-grid HF lens antenna is described. Utilization of these optimized feeds in the lens greatly increases its gain and reduces the theoretical azimuth pattern side lobes, particularly at the low frequency end of the HF band. Measurements made on these optimized feeds confirmed their predicted high efficiency of approximately 50%. The calculated efficiency of the optimized feeds is greater than that of the originally installed feeds by approximately 10 db at the low frequency end of the band and 8 db at the high frequency end of the band. Using a ground-based transmitter the measured power gain increase of the lens using the optimized feeds was approximately 7 db at the low frequency end of the band and approximately 4 db at the upper end of the band. Measured gain increases more closely approximating the feed efficiency increases would be expected if the ground-based transmitter were replaced with an airborne transmitter located at the elevation angles corresponding to the peak of the lens elevation patterns. Author

N66-33181*# RAND Corp., Santa Monica, Calif.
COMMUNICATION SATELLITE OUTPUT DEVICES
N. E. Feldman Sep. 1964 39 p refs Submitted for Publication
(Contract NASr-21-02)
(NASA-CR-59580) CFSTI: HC $2.00/MF $0.50 CSCL 17B

This report reviews and quantitatively compares the various categories of solid state and vacuum tube output devices for communication satellites. Emphasis is placed on the relative ability of semiconductor devices, such as tunnel diodes, transistors, and varactor diodes; and vacuum tube amplifiers, such as triodes, klystrons, amplitrons, and traveling wave tubes, to generate power efficiently at frequencies of 1 to 10 kMc and power levels of 0.1 to 100 watts. R.N.A.

N66-33226# Naval Ordnance Lab., Corona, Calif.
BROAD-BAND VLF TRANSMITTING STAGGER-TUNED DIPOLE
E. W. Seeley and D. A. Wulfing 18 May 1966 27 p refs
(NOLC-653; AD-633859) CFSTI: HC $2.00/MF $0.50

A moderately efficient, easily constructed, broadband vlf transmitting antenna is needed for ionospheric physics research. A low cost, multiconductor, stagger-tuned horizontal dipole was constructed on the Island of Hawaii. Measurements were made to confirm equations that were derived for the input impedance and efficiency. Theoretical and experimental input impedance and efficiency curves are presented for the vlf band. Field strength measurements were made at a distance of 42 km and 4000 km from the antenna, using ten different vlf frequencies. Theoretical and experimental radiated field strengths are compared and show fair agreement.
Author (TAB)

N66-33241# Mitre Corp., Bedford, Mass.
STUDIES OF DISPLAY SYMBOL LEGIBILITY. PART II: LINE SCAN ORIENTATION EFFECTS
Beverly Botha, Donald Shurtleff, and Marion Young Bedford, Mass., AFSC, Electron. Systems Div., May 1966 22 p refs
(Contract AF 19(628)-5165)
(W-06774; ESD-TR-65-138; AD-633851) CFSTI: HC $1.00/MF $0.50

This report delineates effects upon letter legibility produced by horizontal, oblique, and vertical simulated linear TV scan lines. Horizontal lines were parallel to letter bases: the angle between letter bases and oblique lines was 45 degrees; and vertical lines were perpendicular to the letter bases. The results indicate that letter legibility, as measured by response accuracy and letter identification reaction time, is not affected to any significant degree by the scan line angle. In general, the oblique lines yielded the best legibility scores particularly for brief letter exposure times. The main finding of the study was that certain letters remain highly legible regardless of the scan line orientation used for their presentation, and, therefore, are uniquely suitable for TV display. Author (TAB)

N66-33244# Tracor, Inc., Austin, Tex.
ANALYTICAL STUDIES OF DOME-TRANSDUCER INTERACTIONS Summary Report
W. C. Moyer 9 Jun. 1966 42 p refs
(Contract NObsr-91229)
(TRACOR-66-342-U; AD-633973) CFSTI: HC $2.00/MF $0.50

This report summarizes analytical studies conducted during the past year to determine the interaction of sonar domes and transducers during transmission. A general description of the mathematical model used in the analysis is given together with some improvements which have been incorporated in the model during the past year. The results of a study of the dependence of certain performance criteria such as directivity index on the parameters of the dome-transducer model is reviewed. In addition, a general description of developments related to the treatment of viscoelastic dome materials and nonconcentric dome shapes is given. The conclusions drawn in the various technical memoranda submitted during the year are restated in this report. Briefly these are: (a) the dome tends to offset the gains in side lobe reduction obtained by shading the transducer elements, and (b) the most important property of the dome model in determining its effects on various transducer performance criteria is its surface density (product of mass density and thickness). These conclusions are supported by numerical results presented in the report. Finally, some recommendations for the continuance of studies of dome-transducer interactions are given. These include an emphasis on the development of a dome-transducer model of more general configuration and the desirability of an experimental program to support the analytical studies. Author (TAB)

N66-33250# Wisconsin Univ., Madison. Dept. of Electrical Engineering.
WAVEGUIDE, WAVEGUIDE CIRCUITS AND ANTENNA RESEARCH STUDY Quarterly Progress Report, 1 Jun.–31 Aug. 1965
Elmer H. Schaibe 30 Sep. 1965 20 p refs
(Contract DA-36-039-AMC-02261(E))
(QPR-4; AD-633243) CFSTI: HC $2.00/MF $0.50

A study of the measuring system was made using a Hewlett-Packard 851A/8551A Spectrum Analyzer. It was found that under certain conditions a high frequency modulation was present in the output of the stabilized klystron and further that the Dymec stabilizer often locked onto one of the modulation side bands. The largest single loss within the beam waveguide resonator was due to the coupling holes. When the coupling hole loss was accounted for, using an analysis by McCumber, the measured and predicted Q of the beam waveguide resonator operating at 35 GHz were in reasonable agreement. The additional measurements made on the parallel plane resonator indicated that the coupling hole loss was also an important factor in determining the Q. The coupling hole loss cannot be accounted for in the case of the parallel plane resonator since the field distribution within the resonator is not known. It also appears that the Q of the parallel plane resonator depends on the diameter of the end plates.

Author (TAB)

N66-33278# Harry Diamond Labs., Washington, D. C.

CLOSED FORM OF SOME LINEAR-MIXER POWER SPECTRUM INTEGRALS

Paul G. Hershall 6 Dec. 1965 16 p refs

(HDL-TM-65-53; AD-633932) CFSTI: HC $1.00/MF $0.50

Integrals of the type

$$\int_0^\infty g_n(f) \frac{\sin^2 \pi f T}{\pi^2 f^2} \cos 2\pi f\tau \, df$$

where

$$g_n(f) = \left[\frac{f^2 f^2}{(f^2+f^2)(f^2+f^2)}\right]^n, \text{ n integral and positive,}$$

were evaluated in closed form involving triple and double summations. The result was checked by complex integration up to n = 3 and by numerical integration for n = 6. Author

N66-33286# Mitre Corp., Bedford, Mass.

STUDIES OF DISPLAY SYMBOL LEGIBILITY. PART VII: COMPARISON OF DISPLAYS AT 945-LINE AND 525-LINE RESOLUTIONS

Donald Shurtleff and D. Owen May 1966 22 p refs

(Contract AF 19(628)-5165)

(TM-4213; ESD-TR-65-137; AD-633649) CFSTI: HC $1.00/MF $0.50

The legibility of Leroy alphanumerics was determined for 6, 8, 10, and 12 active scan lines per symbol height on a good quality 945-line television system. These results were compared with those of a similar study in which an inexpensive commercial 525-line television system was used. One group of subjects identified symbols displayed by the 945-line system while a second group identified symbols displayed by the 525-line system. The symbols were presented singly, and the speed and accuracy with which the subjects were able to identify them were recorded. The results showed that, even with good quality television, identifications performance deteriorated for resolutions lower than 10 lines per symbol height. Performance for the two television systems was similar for 8, 10, and 12 lines per symbol height; but at 6 lines per symbol height, performance was better for the 945-line television than it was for the 525-line television system. As with previous experiments in this series, 10 lines per symbol height was the lowest resolution recommended for television displays. Author (TAB)

N66-33288# Hughes Aircraft Co., El Segundo, Calif. Space Systems Div.

MARK IV TERMINAL Final Report

Apr. 1965 251 p refs

(Contract DA-28-043-AMC-00121(S))

(SSD-5165R; AD-633560) CFSTI: HC $6.00/MF $1.50

The success of the NASA/Hughes Syncom satellite program created interest regarding the feasibility of a fully operational system of synchronous satellites encircling the earth to provide instant communications 24 hours per day. Such a system was desirable for not only its inherent commercial capabilities, but also as a strategic communications network for military utilization. The U.S. Army (SATCOM Agency at Fort Monmouth, New Jersey) initiated a feasibility investigation. Because of the requirement for any communications satellite to transmit to and from ground stations, the most critical requirement was that of a small transportable station which could be utilized virtually at any spot on earth within the electronic visibility of Syncom's coverage, including the United States. A 10-foot reflector antenna system was constructed and successfully demonstrated its terminal capabilities.

TAB

N66-33295# Litton Systems, Inc., Minneapolis, Minn. Applied Science Div.

LIGHTWEIGHT FLEXIBLE VHF TREE-TOP ANTENNA WITH INFLATABLE MAST Final Report, 1 Jul. 1964-31 Jan. 1966

G. A. Wales, H. P. Raabe, and L. E. Nelson 26 Feb. 1966 100 p refs

(Contract DA-28-043-AMC-00335(E))

(Rept.-2940; AD-633254) CFSTI: HC $3.00/MF $0.75

This program was a research and development effort to improve the portability of VHF antenna systems for military field use. A variety of devices were fabricated which strive to provide an evaluator with meaningful parameters of sizes, weights, durabilities, effectiveness, overall acceptability, etc. Highly mobile means of providing respectable communication ranges in jungle areas are of prime importance. A basic guideline used in this program was an adaptability of techniques or devices for more than one application. For instance, the J antennas are used interchangeably with their chosen elevating device, be it mast or Aerokite. The same inflation fitting is used on the mast and on the Aerokite. Although the electrical devices are designed to be compatible with the elevating devices, they have not been incorporated together as unseparable components. It may be desirable to do so in future applications. Both elevating means are inflatables and require some adaptability by the user. One must realize that a lightweight system will lack durability and be subject to wind loadings. Where portability and effectiveness are of great importance, this trade-off is readily acceptable. Author (TAB)

N66-33356# Sylvania Electric Products, Inc., Williamsville, N. Y.

ELECTRONICALLY STEERABLE ARRAY Final Report, 27 Aug.-31 Dec. 1965

T. R. Schiller and W. S. Heath Griffiss AFB, N. Y., RADC, Apr. 1966 57 p refs

(Contract AF 30(602)-3041)

(RADC-TR-66-16; AD-633495) CFSTI: HC $3.00/MF $0.75

The report describes the effort to design and build a high gain, electronically steerable, millimeter antenna system. The antenna was constructed, adjusted for optimum performance and an extensive testing program carried out. The tests included measurements of radiation patterns at various scan angles, gain measurements, control power requirements, scan speed, and hysteresis effects. Consideration was also given to average and peak rf power and antenna efficiency. Results

indicate that an antenna array of 5 elements is capable of scanning a beam 50 degrees at a rate of one degree per millisecond. The overall efficiency of this array was 60 percent taking into account both the illumination taper and insertion loss in the feed elements. Scanning both the element and array patterns eliminated the grating lobe phenomena normally associated with arrays of many wavelength elements. Author

N66-33396*# Michigan Univ., Ann Arbor. Radiation Lab.
RADIATION OF AN ELEMENTARY CYLINDER ANTENNA THROUGH A SLOTTED ENCLOSURE
A. Olte [1964] 43 p refs Submitted for Publication
(Grant NsG-472)
(NASA-CR-59898) CFSTI: HC $2.00/MF $0.50 CSCL 09F

The shrouding of an elementary cylinder antenna by a concentric perfectly conducting axially slotted shell is considered. The problem is reduced to a Fredholm integral equation of the first kind which is solved for the case of a narrow shell slot. The solution indicates that the slotted shell inhibits the antenna radiation only for certain parameter combinations; for most others, the radiation remains the same and for some it is enhanced. Author

N66-33396*# Texas Univ., Austin.
RADIO ASTRONOMY SIGNAL SPECTRUM ANALYSER
John H. Sizelan (M.S. Thesis) Sep. 1965 36 p refs
(Grant NsG-432)
(NASA-CR-77009) CFSTI: HC $2.00/MF $0.50 CSCL 09F

A device is described for the automatic processing of data by the receiver of a radio telescope. Using a minimum number of components, the device samples, stores, and sums data as well as presents the composite scan at the receiver site. The trigger determines the instants when signal samples are taken; and a motor driven cam–microswitch assembly produces a short negative pulse to the analog-to-digital converter, consisting of a galvanometer-driven signal which directs a light beam on a series of photodiodes which gate the pulses out of the trigger. The crossbar stores the information of one scan and controls the register which displays the composite scan. Design is discussed, along with instrumentation details and operating procedures. A spectrum analyser test and performance results are included. M.W.R.

N66-33430# Ohio State Univ. Research Foundation, Columbus.
ON THE THEORY OF SCATTERING BY AN ARBITRARY ARRAY OF FINITE LENGTH PARALLEL WIRES
Gary A. Thiele 1 Feb. 1966 33 p refs
(Contract N123(953)-31663A)
(Rept.-1522-19; AD-632809) CFSTI: HC $2.00/MF $0.50

It has been shown previously (AD-443 833, AD-463 370, AD-467 888) that a continuous cylindrical metallic surface could be approximated by an array of infinitely long thin wires in order to obtain the far-zone scattered field. Such a technique found useful application in predicting the far-field pattern in the horizontal plane of a thin vertical antenna near a vertical cylindrical scatterer in many, but not all, situations. For instance, valid results could be obtained only if the scatterer was on the order of twice as tall as the antenna, and even then only in the azimuthal plane. As a result it was decided to use wires of finite instead of infinite length to approximate metallic cylinders of finite height. Since the current on each finite wire is non-uniform, it is necessary to represent the current by a Fourier series, the coefficients of which are determined by forcing the total tangential electric field to vanish at several points along each wire. This generates a system of linear equations which can readily be solved on a digital computer for the Fourier coefficients. Some representative calculated and experimental results are presented which show the general validity of the approach. In addition, methods for substantially reducing the running time of the program on the computer are explained. Author (TAB)

N66-33482# Cutler-Hammer, Inc., Deer Park, N. Y.
PRECISION INTEGRATOR FOR METEOROLOGICAL ECHOES (PRIME) Final Report, Apr. 1964–Dec. 1965
Scott F. Hall and David L. Greenberg Dec. 1965 90 p ref *Its* Rept.-3940-1
(Contract AF 19(628)-4163)
(AFCRL-66-158; AD-634311) CFSTI: HC $3.00/MF $0.75

The precision integrator for meteorological echoes (PRIME) is a versatile range-gated, analog integrator used to estimate the mean reflectivity of the radar returns from clouds and storms. A log-IF amplifier converts the returns to the logarithm of the signal amplitude. The range resolution is selectable in seven steps from 0.05 to 0.8 statute mile, with a variable start of range. Contiguous range integration is also included in the same seven steps. The time of integration in all range elements is continuously variable from 5 to 500 msec by a single control. In addition to reflectivity, the output may represent other significant meteorological parameters at the operator's choice. The PRIME equipment has a dynamic range of 80 dB. PRIME will operate with any conventional radar having PRFs from 200 to 5000 pps and pulse widths from 0.5 to 6 μsec. Author (TAB)

N66-33510# Air Force Cambridge Research Labs., Bedford, Mass. Microwave Physics Lab.
ANTENNA POINTING REQUIREMENTS FOR SATELLITE TRACKING
Joseph A. Short, Jr. Feb. 1966 41 p *Its* Instrumentation Papers No. 91
(AFCRL-66-100; AD-634155) CFSTI: HC $2.00/MF $0.50

In order to determine the satellite tracking capability of an azimuth–elevation antenna mount, a simplified model for satellite motion is presented. Satellite azimuth and elevation positional equations versus time are derived and the results of a computer program to determine velocity and acceleration are presented in both tabular and graphical forms. In terms of the results obtained the satellite tracking performance of the AFCRL 29-foot millimeter wave antenna is evaluated. Author (TAB)

N66-33512# Air Force Cambridge Research Labs., Bedford, Mass. Data Sciences Lab.
INFORMATION CONTENT OF LIST-DETECTED FADING M-ARY TRANSMISSIONS
John N. Pierce Apr. 1966 40 p refs *Its* Phys. Sci. Res. Papers No. 211
(AFCRL-66-235; AD-634147) CFSTI: HC $2.00/MF $0.50

The channel capacity achievable for M-ary transmission over a Rayleigh fading channel is analyzed for the Wozencraft–Kennedy list-detection scheme. Calculated capacities are given for both list-detection and decision-detection for several SNRS and for several alphabet sizes ranging up to 4096. In addition, small and large SNR asymptotic expressions for the capacity are given for decision-detection, list-detection, and likelihood-detection. The maximum capacity for arbitrarily large alphabet size is determined. Author (TAB)

N66-33521# International Business Machines Corp., Rockville, Md. Federal Systems Div.
AUTOMATIC ALTERNATE ROUTING STUDY Sixth Quarterly Progress Report, 1 Oct.–31 Dec. 1965
Steve J. Meyers [1965] 52 p
(Contract DA-28-043-AMC-00166(E))
(ECOM-00166-6; AD-634281) CFSTI: HC $3.00/MF $0.50

This report describes a recommended hybrid system which uses complete-path, real-time routing to subscribers whose locations are known, and saturation signaling when locations are not known. Appendixes A and B contain a description of the algorithm used for computing routes and flow diagrams for the call processing procedures. Appendixes C and D are devoted to the derivation of an analytical representation of a network. Author (TAB)

N66-33670 Stanford Univ., Calif.
INFORMATION RETRIEVAL AS A RECEIVER-CONTROLLED COMMUNICATION SYSTEM
William J. Paisley and Edwin B. Parker [1965] 13 p refs
(Grant NSF GN-434)
(PB-169168) CFSTI: HC $1.00/MF $0.50

An outline is presented of the communication process that underlies information storage and retrieval. The viewpoint taken is that of a social psychologist studying human communication, with attention focused on the user and his needs. The information storage and retrieval system is considered as a link in a larger communication system connecting an original source with an ultimate receiver. C.T.C.

N66-33618# Air Force Cambridge Research Labs., Bedford, Mass. Microwave Physics Lab.
TRANSIENT SIGNAL PROPAGATION IN LOSSLESS, ISOTROPIC PLASMAS, VOLUME I Scientific Report
Richard E. Haskell and Carl T. Case Apr. 1966 56 p refs *Its* Phys. Sci. Res. Paper No. 212
(AFCRL-66-234; AD-634083) CFSTI: HC $3.00/MF $0.75

The concept of the wave packet is used to obtain some general results on the propagation of signals in dispersive media. The dispersion of a Gaussian carrier pulse and a square wave carrier pulse in an isotropic plasma is carried out using the wave packet concept. A general analysis of transient wave propagation in isotropic plasmas is given using Laplace transform methods. Solutions are given in terms of series solutions which may be expressed in terms of Lommel functions. Integral solutions which can be easily evaluated numerically are derived using the convolution theorem and using contour integration techniques. The solutions are useful for short dispersion lengths. Author (TAB)

N66-33625# Brown Univ., Providence, R. I. Div. of Engineering.
STUDY OF RADIATION AND PROPAGATION OF ELECTROMAGNETIC WAVES Final Report, Jan. 15, 1963-Jan. 15, 1966
D. M. Bolle et al Mar. 1966 29 p refs
(Contract AF 19(628)-2498)
(AF-2498/9; AFCRL-66-277; AD-634038) CFSTI: HC $2.00/MF $0.50

The work carried out under the contract is described under the following headings: Scattering, Diffraction and Radiation, Interaction of Fields and Plasmas, Propagation through Inhomogeneous Media, Propagation through Anisotropic Media. Author (TAB)

N66-33712# Royal Military Coll. of Science, Shrivenham (England). Electronics Branch.
A THEORETICAL COMPARISON OF THE ACCURACY OF THREE METHODS OF DIRECTION FINDING IN MONOSTATIC RADAR
D. A. James Dec. 1965 23 p refs
(RT-25) CFSTI: HC $1.00/MF $0.50

The note makes a theoretical comparison of the best possible accuracy of static split, of conical scan and of an interferometer with auxiliary dish for a given antenna space. The comparison is made both for the case when the antenna system is used for receiving only and for when it is used in common transmit and receive. Standard conditions are postulated throughout so that the conclusions are strictly comparable. It is concluded that there is little to choose between conical scan and static split in this respect but that the interferometer may offer an advantage if the available aperture width is limited. Author

N66-33781# Texas Univ., Austin. Antennas and Propagation Lab.
THE EFFECTS OF AEROSOLS AND INSECTS IN THE ATMOSPHERE ON THE PROPAGATION OF MICROWAVE SIGNALS
Robert G. Hajovsky and Alfred H. La Grone 1 Jul. 1965 57 p refs
(Grant NSF GP-2596)
(NSF-P-1)

Surface winds and natural convection currents carry dust and microorganisms such as bacteria, pollen spores, and soil algae into the atmosphere. There is evidence of concentrations of these microorganisms at various altitudes indicating biologic stratification due to meteorological conditions. Airborne insects of many types and sizes are found from near the earth's surface to altitudes of approximately 13,500 meters. The altitude at which insects are found is related to insect size, weight, buoyancy and meteorological conditions. Temperature, humidity, barometric pressure, and surface wind intensity affect the relative density of insects found. Aerosols of different types and insects found in the lower atmosphere do, under certain circumstances, yield detectable radar echoes. Normal dust and biological aerosol concentrations found in the atmosphere will not yield detectable radar echoes at microwave frequencies but abnormally high concentrations could. The electrical characteristics, physical characteristics, and distribution density of the aerosols are considered in determining their microwave scattering and reflection properties. Insects could be the source of unexplained radar echoes from apparently clear skies. The electrical characteristics, physical shape, and relative size affect the magnitude of the backscattering characteristics of insects. Author

N66-33780# Lockheed Missiles and Space Co., Palo Alto, Calif.
PULSE-CODE DEMODULATOR WITH ERROR CORRECTION
A. N. Svenson and N. T. Tynnaia [1965] 8 p refs Transl. into ENGLISH from Elem. Otbora i Peredach. Inform. Kiev, Naukova Dumka Press, 1965

The operation of a pulse code error correcting demodulator in which the fundamental link is the logic "and" loop constructed from triodes with direct coupling for negative signals is described. The signals are delivered to the loop inputs either between both the base and emitter of each triode or directly between the base and the common point of the circuit. If pulses of negative polarity are delivered simultaneously to all the inputs, then the triodes are open during the time of pulse operation, a relatively high current flows through the load resistor, and a signal of positive polarity appears at the output. Normal operation of such a demodulator is possible under conditions of triode saturation in the loop. In this case the residual voltage at the emitter-collector junction is negligible. D.T.

N66-33817# Naval Research Lab., Washington, D. C.
OPTICAL CALIBRATION ANALYSIS OF THE U.S. NAVAL SPACE SURVEILLANCE SYSTEM Final Report
L. O. Hayden and T. B. Mc Caskill 25 Apr. 1966 51 p refs
(NRL-6385; AD-633701) CFSTI: HC $2.00/MF $0.50

A preliminary optical calibration of the U.S. Naval Space Surveillance System was made in 1961 using graphical methods. Since then, calibration has been continued using better

equipment and data reduction methods to determine more precisely the characteristics of the system. It is shown that the 108-MH_z system studied is capable of measuring angles within a standard deviation of 1/2 min of arc at zenith. Electronic calibration methods used in setting up the 108-MHz system are shown to have a mean accuracy of approximately 3.5 percent of a wavelength for baselines up through 520 ft in length. Bias errors for baselines of 1040 ft and longer are larger than for the shorter baselines and must be corrected to obtain maximum accuracy from the system. Baselines in the range of 16 to 520 ft have (for echo passes) a mean standard deviation of ±0.034, which is independent of baseline length and angle of arrival and is internal to the system. The random error for longer baselines increases until it reaches a mean standard deviation of ±0.09 for the 5200-ft baseline.
Author (TAB)

N66-33820# Navy Electronics Lab., San Diego, Calif.
SELECTION OF OPERATIONAL MODES IN HF PROPAGATION PREDICTION Research and Development Report, Apr. 1964–Apr. 1965
D. B. Sailors 25 Mar. 1966 27 p refs
(NEL-1364; AD-633893) CFSTI: HC $1.00/MF $0.50

Criteria are given for selecting the operational sky-wave modes in hf propagation prediction for which the signal to noise ratio is to be calculated. Only waves reflected from the F2 layer or the E layer are considered; paths having reflections from both these layers are not considered. In the critical frequency calculations the number of control points varies with path length; the maximum number is five. The program on which this study was based was written in NELIAC 5M for the CDC 1604. Author (TAB)

N66-33834# Institute for Defense Analyses, Arlington, Va. Research and Engineering Support Div.
RADAR MASKINGS BY EARTH'S TERRAIN
John J. Martin Mar. 1966 38 p refs
(Contract ARPA SD-50)
(IDA/HQ-66-4710; P-253; AD-633540) CFSTI: HC $2.00/MF $0.50

The masking of a radar's search volume by earth's terrain is a problem of interest in the placement of radars. In practice, exhaustive surveys and modelled operations may be carried out before final placement is made: it is not the intention of this paper to try to obviate such surveys, but to provide a means based on earth's surface elevation data—such as from contour maps—to determine the sensitivity of a radar's location to its performance, i.e., to give some measure to the intuition which says it's better to be on a hill than in a hole. Author (TAB)

N66-33843# University of Southern Calif., Los Angeles. Electronic Sciences Lab.
RESEARCH IN OPTICAL COHERENCE Final Report
Robert S. Macmillan, Gregory O. Young, James D. Arnett, and William K. Pratt Dec. 1965 20 p refs
(Grant AF-AFOSR-188-65)
(USCEE-168; AFOSR-66-0917; AD-634013) CFSTI: HC $1.00/MF $0.50

Contents: Coherence studies, functional transformations, optical polarization modulation, a test for ergodicity for a certain class of random processes, lens system optimization, bibliography of publications. TAB

N66-33861# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
STUDY OF RECEIVER MIXER CHARACTERISTICS Quarterly Report No. 3, 1 Dec. 1965–1 Mar. 1966
Ernest E. Donaldson, Jr. and Richard W. Moss Mar. 1966 47 p refs *Its* Rept.-3
(Contract DA-28-043-AMC-01426(E))
(ECOM-01426-3; AD-633743) CFSTI: HC $2.00/MF $0.50

Spurious response formations in a 6AS6W pentode mixer and a 6C4 triode mixer were investigated for numerous ordered arrangements of mixer dc parameters, circuit configurations, and signal injection levels. Response levels were measured for different methods of signal and local oscillator injection, and for resistive and tuned load conditions. The results have demonstrated that changes in the mode of signal and/or local oscillator injection, local oscillator level, mixer load conditions, or mixer dc voltages produce changes in response levels that would be difficult to predict. A spurious response prediction technique for diode mixers previously developed at Georgia Tech was investigated to determine if modifications and improvements could be made to reduce prediction errors, and if this technique could be successfully applied to other mixer types. The results of this study are presented in the form of prediction errors derived from the actual prediction of diode and pentagrid mixer data. Maximum-upper-bound prediction methods are discussed, and practical examples of possible techniques are presented. Author (TAB)

N66-33971*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
COMPARISON OF PERFORMANCE OF PCM AND PFM TELEMETRY SYSTEMS
Cyrus J. Creveling Washington, NASA, Aug. 1966 14 p refs
(NASA-TN-D-3476) CFSTI: HC $1.00/MF $0.50 CSCL 09F

A PFM telemetry system can be transformed into a PCM system of equivalent information capacity by a series of steps, outlined in this paper. Since each of these systems can be reduced to a number of discrete digital channels, a quantitative comparison of the systems is obtained by adding to the ratio of the relative powers required to provide equal signal strengths per channel (expressed in dB) the relative powers required to provide equivalent word error rates. Since equivalent channel detectors are assumed, this method is independent of the detecting device as long as the systems are uncoded, that is, when word detection is digit by digit. Author

N66-33974*# Computing Devices of Canada, Ltd., Ottawa (Ontario).
HIGH SHOCK FM TRANSMITTER
14 May 1966 46 p *Its* Rept.-7061/R1
(Contract NAS1-5042)
(NASA-CR-66161) CFSTI: HC $2.00/MF $0.50 CSCL 09F

This report details the specifications of the High Shock FM Transmitter (type VTX-1-2), and provides the engineering data necessary to construct similar units. The engineering drawings of the various mechanical components are included along with electrical assembly drawings and a circuit diagram. Assembly photographs of the transmitter at various stages of construction are also included to supplement and clarify the assembly drawings. A component parts list is also included. Author

N66-33984*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
RANGE RESIDUALS IN VHF RADAR TRACKING
B. Rosenbaum Washington, NASA, Aug. 1966 19 p refs
(NASA-TN-D-3560) CFSTI: HC $1.00/MF $0.50 CSCL 17I

The ionosphere imposes a large bias on the accuracy of tracking at VHF, while the irregularities in the ionospheric density add a fluctuating component to range tracking residuals which is about one percent of the principal range bias. The overall variation of these ionospheric effects is about two orders of magnitude during the diurnal cycle and the eleven-year solar cycle. The range residuals of samples of Imp-I

tracking data are examined to detect tracking noise having an ionospheric origin. The data show fluctuating residuals of about 15 meters rms and an anomalous, systematic variation on the order of 100 meters, which could be attributed to the tracking system. The negligible role of ionospheric irregularities observed in range residuals is consistent with the current epoch of the quiet sun. Author

N66-34008# Joint Publications Research Service, Washington, D. C.
BURIED ANTENNAS
G. A. Lavrov and A. S. Knyazev 11 Aug. 1966 41 p Transl. into ENGLISH from the book "Prizemnyye i Podzemnyye Antenny" Moscow, Sovetskoye Radio, 1965 p 256-297
(JPRS-36945; TT-66-33375) CFSTI: $2.00

Using the theoretical propostions set forth in the literature, various aspects of buried antennas were examined. The current distribution along an underground dipole was determined by solving an integral equation similar to the corresponding equation for ordinary dipoles in free space. Input impedance is discussed, and the results of calculations are tabulated. These data indicate that the possibilities of enhancing the effectiveness of antennas buried directly in the ground by increasing their size are very limited. Dipoles with dielectric coverings are considered, and relations were obtained for determining the wave impedance of such systems and the propagation constant. Wave impedance and propagation constant were shown to be practically independent of the distance from the interface, except for extremely thin surface layers. The basic electrical characteristics of underground antennas were calculated, and it was concluded that horizontal buried dipoles are more effective in communications than vertical ones. Directional characteristics and gain are considered, and directional diagrams are given to compare buried and surface antennas. Spreading antennas are also discussed in relation to gain.
L.E.W.

N66-34034# Hughes Aircraft Co., Fullerton, Calif.
INVESTIGATION OF USE OF SUPERIMPOSED SURFACE WAVE MODES Final Report No. 1, 1 Feb. 1965-31 Jan. 1966
N. S. Wong, S. Sheaffer, and R. Tang 28 Feb. 1966 90 p refs
(Contract AF 19(628)-4984)
(AFCRL-66-200-I; AD-631936) CFSTI: HC $3.00/MF $0.75

A novel method of achieving a matched radiating element in a phased array antenna over a specified scan angle has been investigated. The radiating element consists of an open-ended waveguide supporting the two lowest order modes. Each of these modes excites a surface wave along the array. When appropriately superimposed, the two surface waves yield the correct shape of mutual impedances which produce a constant driving point impedance over a specified scan angle when all elements in the array are driven. The existence of these surface waves has been verified by the experimental investigations. The near fields, both of the radiation and the induction types, were shown to be important under certain conditions. Using a scattering formulation instead of impedance formulation, this method of control of driving point impedance can be regarded as combining two or more modes such that the reflections of these modes tend to cancel each other at the driven terminals. A VSWR of less than 1.2 to 1 over a $\pm 60^{\circ}$ scan angle from broadside was obtained theoretically for a linear array of open-ended waveguides supporting the two lowest order modes. Author

N66-34062# Stanford Univ., Calif. Radioscience Lab.
DIGITAL DETECTION OF BINARY CODED RADAR SIGNALS Interim Scientific Report No. 2
Philip M. Spira Jan. 1966 17 p refs
(Contract AF 19(628)-3996)
(SEL-66-001; AFCRL-66-253; AD-634564) CFSTI: HC $1.00/MF $0.50

This report describes a method for locating one or two radar targets using pseudorandom coding and digital processing of the return signal. The process time required is twice that of a matched filter, but instrumentation is simpler. If two targets are present, they are resolved proportional to the strength of their echoes in the high noise case, provided their relative phase is slowly varying. Author (TAB)

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N66-33089# California Univ., Berkeley. Dept. of Mathematics.
A SEARCH METHOD IN CONVEX PROGRAMMING
Michael Rogson Feb. 1965 61 p refs
(Contract Nonr-222(85))
(AD-619211) CFSTI: HC $3.00/MF $0.75

A search method for solving both the linear programming problem and a more general class of convex programming problems with the 7090 computer, using artificial evolution techniques, is presented. Flow diagrams are given for the program. In special cases, the results of this method and the known values are compared. Also tables of the computed results are given. Author (TAB)

N66-33107# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.
AN INVESTIGATION INTO THE USEFULNESS OF AN IMMEDIATE ACCESS COMPUTER IN CRITICAL PATH PLANNING
E. E. Aldrige Mar. 1966 17 p refs
(AERE-M-1719)

To investigate the usefulness of an immediate access computer in critical path planning (about 200 activities), a critical path analog computer (15 activities) using eight standard "off the shelf" Harwell 2000 series units together with three special units was assembled. A description of these is given. The computer primarily permitted adjustment of the resource requirement by varying the slack times and was set up to deal with the manufacture of a pump unit where the start times of the fifteen activities were needed to be adjusted in order to optimize the demand on two resources. It became obvious that the purely analog computer was only suitable for dealing with very small numbers of activities (although a very convenient way of building a demonstration machine) and that an immediate access computer would have to be digital for any reasonable number of activities. The usefulness of such a machine was not so apparent. While the ability to play with a relatively simple machine did enable correlations to be seen and evaluated which would not otherwise have been apparent, on a 200 activity machine a very large number of parameters would be available requiring some skill for optimum adjustment. If such skill were not easily acquired, the usefulness of such a machine to an engineer, trying to get a "feel" for his problem, would be considerably diminished. Author

N66-33234# Library of Congress, Washington, D. C. Aerospace Technology Div.
COMPUTER TECHNOLOGY Surveys of Soviet Scientific and Technical Literature

Boris Doncov 1 Apr. 1966 46 p refs Compilation of abstracts (ATD-66-37; AD-633892) CFSTI: HC $2.00/MF $0.50

The 38 abstracts are arranged alphabetically by author within each of the following categories: components (5 entries), design (10 entries), applications (11 entries), and associated systems (12 entries). A bibliography comprising 38 entries is included. Other information included: tunnel diode memory cell, transfluxors, parametron, three-phase pulse generator, switching diode, cryotron memory unit, digital computer, digital computer storage of meteorological information, document information retrieval system, analog computer, program control, computer photoreaders, automatic programming, automatic control, analog–digital multipliers, magnetic tape signal coding, digital counter, computer circuit. Author (TAB)

N66-33272# Sylvania Electric Products, Inc., Mountain View, Calif. Electric Defense Labs.

THE APPLICATION OF CARROLL'S TECHNIQUE TO COMPUTER-AIDED DESIGN

E. A. Huber 17 Sep. 1965 63 p refs

(Contract DA-28-043-AMC-00379(E))

(EDL-M881; AD-633613) CFSTI: HC $3.00/MF $0.75

Network synthesis and transfer-function estimation are considered as parameter-estimation problems. Particular emphasis is given to the synthesis of linear electrical networks. To minimize the desired error measure, iterative gradient techniques are used to adjust the parameters automatically. Constraint equations to insure physical realizability are handled by means of Carroll's nonlinear programming technique. This technique transforms the minimization-with-constraints problem into an unconstrained minimization problem. The result is an automatic procedure which requires the designer's experience in setting up the problem but uses the digital computer to perform the tedious labor. Pertinent examples of this procedure are presented. Author (TAB)

N66-33277# North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.

ORBIT DIFFERENTIAL CORRECTION—TRACKING PROGRAM. VOLUME II: PREPROCESSOR FOR THE DIFFERENTIAL CORRECTION PROGRAM Final Report

George E. Townsend Griffiss AFB, N. Y., RADC. 18 May 1966 238 p

(Contract AF 30(602)-3638)

(SID-65-1203-2; RADC-TR-66-67, Vol. II; AD-633721) CFSTI: HC $6.00/MF $1.25

The preprocessor for the differential corrections geocentric orbit computations program (FS4-305A) is a data handling routine required in the reduction of satellite observations, and the computation of the associated trajectories. This program reads a specially generated magnetic tape containing coordinate data observations from a series of tracking stations. The data is smoothed, using least squares criteria, and then ordered. Primary ordering is time and secondary ordering is by station. Output includes a magnetic tape which is required as input for the differential corrections geocentric orbit computations program (FS4-305). Author (TAB)

N66-33279# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

FORMAT-DIRECTED LIST PROCESSING IN LISP Scientific Report No. 3

Daniel G. Bobrow and Warren Teitelman Bedford, Mass., AFCRL, Apr. 1966 33 p refs

(Contract AF 19(628)-5065; ARPA Order 627)

(AFCRL-66-302; AD-633242) CFSTI: HC $2.00/MF $0.50

This report describes a notation and a programming language for expressing, from within a LISP system, string transformations such as those performed in COMIT or SNOBOL. A simple transformation (or transformation rule) is specified by providing a pattern which must match the structure to be transformed and a format which specifies how to construct a new structure according to the segmentation specified by the pattern. The patterns and formats are greatly generalized versions of the left-half and right-half rules of COMIT and SNOBOL. For example, elementary patterns and formats can be variable names, results of computations, disjunctive sets, or repeating subpatterns; predicates can be associated with elementary patterns which check relationships among separated elements of the match; it is no longer necessary to restrict the operations to linear strings since elementary patterns can themselves match structures. The FLIP language has been implemented in LISP 1.5 and has been successfully used in such disparate tasks as editing LISP functions and parsing Kleene regular expressions. Author (TAB)

N66-33280# MITRE Corp., Bedford, Mass.

HOW TO ESTIMATE THE INVESTMENT COST OF ELECTRONIC DATA PROCESSING EQUIPMENT

Martin V. Jones Bedford, Mass., AFSC, Electron. Systems Div., May 1966 39 p refs

(Contract AF 19(628)-5165)

(MTR-70; ESD-TR-66-71; AD-633878) CFSTI: HC $2.00/MF $0.50

This document seeks to provide practical guidance to analysts charged with estimating the investment costs of the electronic data processing equipment of Air Force Command and Control systems. The document is also offered as a methodological prototype for writing similar item-oriented reports on other major items or Air Force systems, such as communications equipment, radar, sensors, display equipment, computer programming, and the major subsystems of aircraft, ballistic missiles, and space systems. Author (TAB)

N66-33296# Columbia Univ., New York. Dept. of Electrical Engineering.

STUDY OF A COMPUTER DIRECTLY IMPLEMENTING AN ALGEBRAIC LANGUAGE Final Report, 1963–1965

Theodore R. Bashkow, Azra Sasson, and Arnold I. Kronfeld Jan. 1966 171 p refs /*ts* Tech. Rept.-87

(Contract AF 19(628)-2798)

(AFCRL-66-95; CU-11-65-AF-2798-EE; AD-633727) CFSTI: HC $5.00/MF $1.00

A system design is given for a computer capable of direct execution of Fortran source statements. The allowed types of statements are the Fortran arithmetic, do, go to, computed go to, arithmetic if, read, print, dimension, continue, pause and end statements. Up to two subscripts are allowed for variables and no format statement is required. The programmers source program is converted to a slightly modified form while being loaded and placed in a program area in lower memory. His original variable names and statement numbers are retained in a symbol table in upper memory, which also serves as the data storage area. During execution of the program each Fortran statement is read and interpreted at basic circuit speed since the machine is a hardware interpreter for these statements. The machine corresponds therefore to a 'one-pass, load-and-go' compiler except, of course, that there is no translation to a different machine language. The design information is presented in the form of mealy state diagrams for each of the statement circuits. A method is also described for going from the state diagrams to the logic circuits which generate and sequence the required microsteps (register gate control signals, memory read and write commands, etc.). Author (TAB)

N66-33361# System Development Corp., Santa Monica, Calif.
[TIME-SHARING, DATA BASE SYSTEMS, COMPUTER PROCESSING OF NATURAL LANGUAGE, AND THE RESEARCH AND TECHNOLOGY LABORATORY] Semiannual Technical Summary Report, 18 Nov. 1965–17 May 1966
C. Baum, ed. [1966] 54 p
(Contract AF 19(628)-5166; ARPA Order 773)
(TM-687/006/00; AD-633930) CFSTI: HC $3.00/MF $0.50

This report describes work done in the ARPA-sponsored information processing techniques and command and control research and laboratory program for 18 November 1965 through 17 May 1966. Projects covered are time-sharing, data base systems, computer processing of natural language, and the research and technology laboratory. Author

N66-33416*# Kansas Univ., Lawrence.
ASSOCIATIVE RETRIEVAL BY DYNAMIC TRANSFORMS
Wilburn O. Clark (Gen. Elec. Co., Huntsville, Ala.) [1964] 18 p ref Presented at the Southeastern Regional Meeting of Assoc. for Computing Machinery and Southeastern Simulation Council, Atlanta, 16 Oct. 1964
(Grant NsG-298)
(NASA-CR-59810) CFSTI: HC $1.00/MF $0.50 CSCL 05B

The realization of associative memory techniques on conventional digital computers is demonstrated using only a single search cycle which allows for computing an address and binary comparison. A class of dynamic functions which utilize the a priori information available during the recording operation is evaluated. The flexibility of a trade-off between program running time and computer memory is illustrated. A comparison of various associative memory organizations is made by considering applications to the field of information retrieval. The feasibility of a real-time information processing system is demonstrated. Both the input and output are assumed to conform to the rules of language specification disclosed. The structure of the syntax allows three types of associative operations: (1) record a given record with a Boolean OR expression of associated keys, (2) erase a record from association with each one of a Boolean OR expression of keys, and (3) retrieve all records associated with a Boolean expression. Author

N66-33575 Sandia Corp., Livermore, Calif.
SHOCK PULSE COMPUTER
R. S. Jacobson Apr. 1966 25 p refs Supported by AEC
(SCL-DC-66-2) CFSTI: $1.95

A shock pulse computer has been designed which enables easy determination of a number of mechanical shock test parameters. The computer may be used for square, half-sine, triangular, haversine, and parabolic-cusp pulses. Pulses involving no rebound may be symmetrical or skewed; those involving rebound must be symmetrical. Author

N66-33635# System Development Corp., Santa Monica, Calif.
COMPUTERIZATION: SOME IMPLICATIONS FOR DECISION MAKING
G. H. Perry 30 May 1966 17 p refs
(SP-2487; AD-633908) CFSTI: HC $1.00/MF $0.50

Decision making is discussed both in a broad economic context and in a specific definitional sense, and is then related to the information revolution, or computerization. The directional and dimensional changes in the decision making process that appear to be imminent or already underway are described, and predictions are made of the effects these changes will have upon managers' jobs in the near-term future. Author (TAB)

N66-33653# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF THE ALGORITHM USED IN A SPECIALIZED DIGITAL COMPUTER FOR CONVERSION OF EQUATORIAL COORDINATES TO AZIMUTHAL COORDINATES
S. V. Korotkov, V. A. Myasnikov, and V. T. Pivovarov 18 Feb. 1966 18 p refs Transl. into ENGLISH from Akad. Nauk SSSR. Inst. Elektromekhan. (Moscow), issue 9, 1963 p 87–101
(FTD-MT-65-415; TT-66-61400; AD-633661) CFSTI: HC $1.00/MF $0.50

An algorithm used in a specialized digital computer for conversion of equatorial coordinates to azimuthal coordinates was investigated for simplicity, accuracy, and for the generality of its method of construction. The following conclusions were reached: (1) The circuit for conversion is simple, requiring only ten full integrators. (2) To achieve an error on the order of 10^{-6} for the computed values of the azimuth and the zenith distances 20 binary digits are sufficient. (3) The method of construction of the coordinate converter from digital integrators and the analysis of the interactions of its separate elements can also be used for solutions of other mathematical problems on digital differential analyzers. D.T.

N66-33822# System Development Corp., Santa Monica, Calif.
MATRIX MANIPULATIONS BY COMPUTER: DIRECT NUMERICAL PROCEDURES FOR BASIC MATRIX OPERATIONS
John Staudhammer (Ariz. State Univ.) 6 Apr. 1966 86 p refs
(TM-2891/000/00; AD-633928) CFSTI: HC $3.00/MF $0.75

This paper describes a set of computer programs that develop a number of reasonably complex routines for determinant evaluation, solution of simultaneous equations, and matrix inversion; the programs are derived from a simple Gauss elimination technique for finding the value of a determinant. The computer routines illustrate the application of pivot searching to each of the above tasks and are intended to be used as library routines for arbitrarily stored matrices. The bulk of the programs were written in a version of Fortran II that is compatible with Fortran IV and were checked and compiled on a Philco 2000 (ALTAC III), a CDC 3400, an IBM 7094, a GE 225, and an IBM 1620 (Fortran II). The programs are intended as a graded sequence for teaching the principles of efficient programs for matrix manipulations. Each program can be optimized for a given compiler, but such optimization will probably result in programs that will not compile correctly on other computers. The programs thus represent a generally useful set of relatively efficient subroutines. Author (TAB)

N66-33842# Navy Electronics Lab., San Diego, Calif.
SERIAL DIGITAL COMPUTATIONAL UNITS: TECHNIQUE DEVELOPMENT. SINE-COSINE FUNCTION GENERATORS AND SUPPORTING TECHNIQUES ARE APPLIED IN A BREADBOARD INTERCEPT COMPUTER
L. G. Harris and H. Nathan 23 Nov. 1965 231 p ref
(NEL-1332; AD-634086) CFSTI: HC $6.00/MF $1.25

Sine-cosine function generators using digital-differential-analyzer techniques and capable of three modes of operation were designed and evaluated. The units were expanded into a breadboard intercept computer system by development of ancillary digital techniques. Author (TAB)

N66-33848# Atomic Weapons Research Establishment, Aldermaston (England).
DICE MK. VI THE PREPARATION OF NUCLEAR DATA INTO A FORM SUITABLE FOR MONTE CARLO CALCULATIONS USING AN ELECTRONIC COMPUTER

J. B. Parker, ed. May 1966 104 p refs
(AWRE-O-27/66) HMSO: 14s

The nuclear data used in multigroup neutronics calculations on a high speed digital computer at AWRE are characterized by their vastness and their complexity. The task of synthesizing the data (for a given nuclide), embracing as it does the intercomparison of different experiments, weighting them in accordance with their general reliability and interconsistency, is a laborious and highly specialized procedure. The product of this synthesis is the UKAEA Nuclear Data Library, in the form of punched cards, which follows a definite format. Included is a description of the way in which the contents of the UKAEA Nuclear Data Library are converted for use in calculations employing the Monte Carlo method. NSA

N66-33956# Atomics International, Canoga Park, Calif.
ANALOG COMPUTER FOR THE ARGON FLUX MONITOR
K. H. Kline 25 May 1966 21 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-11355) CFSTI: HC $1.00/MF $0.50

An analog computer was designed and constructed for the purpose of solving any one of several equations to determine neutron flux by the activation of argon gas flowing through a piping system in a nuclear reactor. Inputs to the computer are from transducers measuring counting rate, pressure, mass flow, and temperature. Author (NSA)

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N66-32716# Westinghouse Electric Corp., Baltimore, Md. Electronics Div.
A SURVEY OF ADAPTIVE COMPONENTS FOR USE IN FAILURE-FREE SYSTEMS Special Technical Report No. 1
Aug. 1963 18 p refs
(Contract NASw-572)
(NASA-CR-55039) CFSTI: HC $1.00/MF $0.50

A survey of component reliability of adaptive components for use in failure-free systems, and electrochemical, and magnetic devices was evaluated. It was found that the magnetic devices, such as the MAD (multi-aperture device), and the orthogonal core, second harmonic, and magnetostrictive integrators, appear to offer the least hope for providing analog memory with long-term stability. The degradation in reliability as a result of this complexity represents a liability which makes practical application doubtful for redundant systems. Of the electrochemical devices, the memistor and the solion present stability problems, and the solion appears to be somewhat more practical if size is not an important consideration. The mercury cell integrator with photoelectric readout is considered in principle to offer the most attractive approach because of its simplicity, stability and general compatibility with conventional circuitry. R.Ll.

N66-32783*# General Precision, Inc., Glendale, Calif. Librascope Group.
STUDY OF FAILURE AND RELIABILITY IN MICROELECTRONIC DEVICES Third Quarterly Report
May 1966 40 p
(Contract NAS12-72)
(NASA-CR-76883; TR-2-0426) CFSTI: HC $2.00/MF $0.50 CSCL 09A

Electronic component testing is reported in the areas of lifetime, temperature cycling, temperature step stress, and failure analysis. Performance of the five device types tested is summarized. Tabulations containing the number of failures that occurred at the significant measuring points are included. S.P.

N66-32785*# General Precision, Inc., Glendale, Calif. Librascope Group.
STUDY OF FAILURE AND RELIABILITY IN MICROELECTRONICS DEVICES Second Quarterly Report
Feb. 1966 26 p *Its* Rept.-2-0418
(Contract NAS12-72)
(NASA-CR-76882) CFSTI: HC $2.00/MF $0.50 CSCL 09A

The life test data indicate that the devices are exhibiting stable parameter characteristics with exception of the erratic response of the reverse diode leakage current for Vendor A. The completion of the temperature cycling indicates that Vendors B and C appear to have been unaffected, while Vendor A experienced thermo-compression bond failures. The testing of the two new Vendors, D and E, has started with the discontinuation of testing Vendor D until problem areas are resolved. The failure analysis has shown that in addition to purple plague, imperfections in the di lectric coating have constituted the major source of difficulty. Improvements in the inspection procedure and alternative dielectric coating materials are recommended as a means to both minimize the purple plague and obtain low leakage current circuits. Author

N66-32821# Princeton Univ., N. J. Elementary Particles Lab.
SENSITIVITY OF IMAGE INTENSIFIER-FILM SYSTEMS FOR OBSERVING WEAK LIGHT SOURCES Technical Report No. 1
George T. Reynolds and P. Botos 15 Feb. 1965 30 p refs
(Contract AT(30-1)-3406)
(NYO-3406-1) CFSTI: HC $2.00/MF $0.50

A representative systematic evaluation of an image intensifier-film system was described. The important parameters of tube gain, cathode efficiency, noise, film sensitivity, image quality, and signal to noise ratio were discussed. Although individual parameters and criteria will vary from problem to problem, the principles described afford a means for determining the factor of improvement that may be realistically assigned to the image intensifier system in certain particular applications for the observation of weak light sources. Author (NSA)

N66-32846# California Univ., Berkeley. Lawrence Radiation Lab.
SOME SOLUTIONS TO DATA-HANDLING PROBLEMS ASSOCIATED WITH THE MAGNETOSTRICTIVE SPARK CHAMBER
Frederick A. Kirsten, Kai L. Lee, and James Conragan 2 Mar. 1966 19 p refs Presented at the Inst. of Elec. and Electron. Engr., Scintillation and Semicond. Counter Symp., Washington, D. C., 2–4 Mar. 1966
(Contract W-7405-ENG-48)
(UCRL-16539; CONF-660304-7) CFSTI: HC $1.00/MF $0.50

The invention of the magnetostrictive spark chamber has created problems in detecting, digitizing, and storing the data from arrays of such chambers. These arrays are expected to vary widely in size from one experiment to another. The system of electronics developed for such use should be easily adapted to arrays for different sizes, and economically feasible for use with the largest arrays. Such a system is described.

The basic components of the system are a preamplifier, timing discriminators, and digitizing and storage electronics. The preamplifier, designed to be mounted at the spark chamber, uses an integrated-circuit operational amplifier. It amplifies and clips the pulses from the transducer. The zero-crossing timing discriminator uses a tunnel diode in a cock-trigger circuit. The timing characteristics of the discriminator with expected variations in input pulse shape are described. The digitizing of spark location is accomplished with start/stop scalers operating with a 20-MHz clock. Scalers of 12-bit capacity can be used with chambers as large as 1 meter on a side. The digitizing and storage electronics was designed in modular form. The number of channels (transducers) and the number of sparks per gap can be expanded or contracted as required by a given experiment. The system can be used with any of three modes of connecting the transducers: parallel, series, or parallel-series. The use of integrated circuits has led to simplifications in the design and economies in production. Author (NSA)

N66-32850# Atomic Energy Commission, New York. Health and Safety Lab.

SINGLE-CHANNEL ANALYZER: HASL TYPE TM-41

D. C. Freeswick and R. T. Graveson 4 Apr. 1966 41 p refs
(HASL-66-4) CFSTI: HC $2.00/MF $0.50

A single channel analyzer is described in detail. Specifications, general description, operational description, internal adjustments, and circuit descriptions are given. NSA

N66-33120# Atomic Energy of Canada, Ltd., Chalk River (Ontario).

A SIMPLE APPROACH TO THE DESIGN OF SOME TUNNEL DIODE SWITCHING CIRCUITS

R. V. l'Archeveque Nov. 1965 88 p refs
(AECL-2515) CFSTI: HC $3.00/MF $0.75

The tunnel diode is compared to the ordinary junction diode and a simplified qualitative explanation shows the influence of doping levels in the semiconductor material on the resulting electrical characteristics. A few practical remarks are made on the design of tunnel diode amplifiers and oscillators. The tunnel diode switching action is described in detail, considering only the static electrical characteristic and the total parallel capacitance across the diode. This study is part of an analysis of problems arising in the use of tunnel diodes in long chains as scalers or to generate accurately defined staircase waveforms to serve as voltage stepping references. A relaxation oscillator is analyzed using a linear approximation of the tunnel diode characteristic. From this analysis, a general method is developed for the design of various tunnel diode-transistor hybrid switching circuits; it gives a timing precision better than ±5% for frequencies up to about 20 Mc/s. Application of the method to the design of one-tunnel diode flip flops, monopulsers, relaxation oscillators and an adjustable voltage level discriminator is illustrated. It is maintained that the technique provides a simple though powerful tool for the design of tunnel diode switching circuits. Author

N66-33145# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.

THE AUTOMATION OF ELECTRONIC PACKAGING

M. N. Weindling (1966) 14 p refs Presented at Natl. Electron. Packaging and Production Conf., New York, 21–23 Jun. 1966
(Rept.-3741)

The problems involved in the packaging of electronics are discussed and some of the ways in which computer implemented automation can aid the designer are indicated through examples. It is pointed out that any phase of electronic design may be defined explicitly as a procedure that can be implemented via a computer and that the results may be expressed as both output drawings and control tapes for automatic devices. Three basic means by which allocation at any level can be performed, i.e., arbitrary assignment or assignment based on experience, iterative procedure, and the use of a connectivity function, are described and their weaknesses outlined. L.E.W.

N66-33170*# Texas Univ., Austin. Electronic Materials Research Lab.

MICROELECTRONICS RESEARCH ON SILICON–SILICON OXIDE STRUCTURES AND INTERFACES Quarterly Report No. 2, 1 Sep.–30 Nov. 1964

30 Nov. 1964 112 p refs
(Contract NAS8-11235)
(NASA-CR-57826) CFSTI: HC $4.00/MF $0.75 CSCL 09A

The development of capability towards satisfactory completion of the program continues. Some of the considerable recently-published information on M-O-S structures is reviewed. A major point of agreement on space charge in the oxide has been reached. The experimental program now has operating the process furnace, the electrolytic etching fixture, the capacitance bridge, the replication evaporator, and the electron microscope. The deionized water system produces 18 meg ohm-centimeter water. Simple usage of photolithographic techniques has been satisfactorily demonstrated. Fluorescence techniques appear to offer a sensitive analytical tool for measuring the organic content in deionized water supplies. Investigations to evaluate the utility of the techniques can be performed with additional equipment. Electron mirror microscopy appears to need further development to have the resolution desired for cross section investigations. For studying the uniformity and structure of oxide surfaces this tool could be quite useful. New general bibliography sections cover report literature recently surveyed. Author

N66-33239# Naval Radiological Defense Lab., San Francisco, Calif.

THE EFFECT OF RADIATION INDUCED CHARGE ON TRANSISTOR SURFACES

Roe J. Maier 21 Mar. 1966 85 p refs
(USNRDL-TR-997; AD-633468) CFSTI: HC $3.00/MF $0.75

The deleterious effects of 1000 to 10,000 rads absorbed dose on transistors are analytically studied to determine the mechanisms. Several mechanisms for producing surface charge at the transistor junctions are important. The effect of the charge on the width and depth of the channel at the collector junction causes an increase of collector leakage current I_{cbo} when the sign of the charge is such as to drive the surface potential toward inversion. Variations of the transistor gain are due to the variations of the surface recombination velocity, which is a function of surface potential. It is suggested that mitigation be achieved by attempting to eliminate the variations of transistor surface potential. This can be accomplished by preventing the charging of the surfaces and surrounding medium. Author (TAB)

N66-33270# General Electric Co., Syracuse, N. Y. Research and Development Center.

SUPER POWER CW TRANSMISSION LINE TECHNIQUES Interim Report, Jul. –Dec. 1965

Kiyo Tomiyasu et al Griffiss AFB, N. Y., RADC, 26 May 1966 69 p refs
(Contract AF 30(602)-3810)
(RADC-TR-66-124; AD-633521) CFSTI: HC $3.00/MF $0.75

Various types of waveguides for the purpose of propagating very high average power with very low loss have been investigated. The most promising mode is considered to be the TE_{01} mode in greatly oversized circular waveguides. Tentatively the waveguide diameter is about 30 inches for X-band

operation with an attenuation of about 3×10^{-6} dB/foot. After investigating several taper designs and fabrication techniques, the multi-conical design approach has been selected for this program. The large diameter portions of the taper and the full-size circular waveguide sections will likely be fabricated from sheet metal which is rolled, welded and reinforced. Rectangular waveguide test tapers have been designed and fabricated, by using these, mode conversion characteristics will be measured. A spinning dipole mode analyzer will be used to measure mode conversion in the circular waveguide. Assembly of the components has been started. Author (TAB)

N66-33276# Hamilton Standard Div., United Aircraft Corp., Broad Brook, Conn.
MICROBONDS FOR HYBRID MICROCIRCUITS Quarterly Progress Report No. 8, 1 Nov. 1965–31 Jan. 1966
A. R. Riben and S. L. Sherman Fort Monmouth, N. J., Army Electron. Labs., 20 May 1966 111 p refs
(Contract DA-36-039-AMC-03742(E))
(HSER-3145; ECOM-03742-8; AD-633723) CFSTI: HC $4.00/MF $0.75

The mechanical strengths (1) 0.001 inch Al wire ultrasonically bonded to Au/Cr films on as-fired alumina, (2) 0.005 inch Au wire resistance welded to Au/Cr films on sapphire, (3) 0.002 inch Au wire resistance welded to Au/Cr films on beryllia, (4) 0.005 inch wire resistance welded to Au/Cr films on beryllia, (5) 0.001 inch Al wire ultrasonically bonded to Au/Cr films on sapphire, (6) 0.002 inch Al wire ultrasonically bonded to Au/Cr films on sapphire and (7) 0.002 inch Al wire ultrasonically bonded to Au/Cr films on beryllia were evaluated. The reliability goal of an expected failure of no more than 3 bonds per thousand at the 90% confidence level was met for the No. 3 and 4 microbonds. Electrical resistance measurements demonstrated that all bonds completed to date met the contractual goal. Thermal aging tests indicated that a number of bond types met the contractual goal for a temperature of 125°C, and of these all but one met the goal at 200°C. Stack welded microbonds consisting of 0.002 in. Au-plated-Ni wire welded to Ni/Au/Cr. Author

N66-33285# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
QUARTZ CRYSTAL AGING EFFECTS Semiannual Report No. 2, 15 Aug. 1965–15 Mar. 1966
Richard B. Belser and Walter H. Hicklin Fort Monmouth, N. J., Army Electron. Labs., Mar. 1966 93 p refs *Its* Rept.-10
(Contract DA-36-039-AMC-02251(E))
(ECOM-02251(E)-10; AD-633724) CFSTI: HC $3.00/MF $0.75

The purpose of this research is to reduce the aging and failure rates of quartz resonators, thereby increasing their reliability. Aging measurements at 85°C of 84 resonators distributed among the frequencies, 81.9, 100, 250, 455, and 500 kilocycles, and among the edge finishes, optically polished, optically polished and etched, and state of the art, revelaed little variation in aging rates that might be ascribed to the finish. A series of 10 Mc reliability units aged at 125°C exhibited aging behavior dependent on the container type and the accompanying bakeout temperature used. A series of 176 aluminum and gold plated 3 Mc resonators were fabricated, and measured at 85°C. A yield of 67% of units capable of meeting the specificaton less than $\times 10^{-9}$ week after the first 30 days was obtained in spite of several different exploratory fabrication methods employed among the first fabricated resonators. Preliminary fabrication and aging studies of 5 Mc resonators, with aluminum annular ring electrodes, produced units with an average Q of 1,660,000 and very low aging rates. X-ray diffraction topography and SID studies have given valuable aid in analyzing aging anomalies in the design of annular ring electrodes, and in the recognition of fundamental and inharmonic modes. TAB

N66-33287# Texas Instruments, Inc., Dallas.
PRODUCTION ENGINEERING MEASURES (PEM) FOR A GERMANIUM MICROWAVE TRANSISTOR Quarterly Progress Report No. 6, 30 Sep.–31 Dec. 1965
[1966] 50 p refs
(Contract DA-36-039-AMC-03632(E))
(TI-03-66-24; AD-633976) CFSTI: HC $2.00/MF $0.50

Electrical specifications of the PEM device (type L-148) have been incorporated into the electronics command technical requirements SCL-7730B. They are included in this report. Final approval of the specifications have not yet been announced by USAEC. Forty preproduction samples fabricated during the report period have been tested according to 'specification for transistor, microwave, germanium (1.5 GHz, 3.0 GHz) type L-148'. Electrical data on these samples are enclosed. During this report period, a technical problem encountered was caused by defective slice resistivity measuring apparatus. The problem has been corrected and acceptable substrate material is being received. The L-148 pattern is now being used exclusively on the preproduction line. Progress is being made toward realizing the full capability of PFM facilities. A revised list of PEM electrical and environmental test equipment is enclosed. Author (TAB)

N66-33305# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
PRODUCTION ENGINEERING MEASURE FOR SILICON LINEAR INTEGRATED CIRCUITS Quarterly Progress Report, 20 Oct. 1965–20 Jan. 1966
Robert Mc Ginnis, Thomas Quaid, Thomas Monaghan, and John Hatchett [1966] 37 p
(Contract DA-36-039-AMC-06158(E))
(QPR-3; AD-633496) CFSTI: HC $2.00/MF $0.50

The report describes the work accomplished to produce silicon linear integrated circuits of the type used in FM receivers. During this interval, the effort was devoted to producing and evaluating engineering samples of the five different integrated circuits which are to be used in the fabrication of an FM receiver. A modification in the audio amplifier circuit, which will permit a nearly optimum circuit performance, was determined and alteration of the integrated circuit mask set was initiated to incorporate this change. The formalization of circuit test procedures and the construction of an engineering model receiver was also begun during this reporting period. Author (TAB)

N66-33354# Honeywell, Inc., Hopkins, Minn.
DIFFUSED RESISTOR TEMPERATURE COEFFICIENT IMPROVEMENT Final Report, 2 Feb. 1965–1 Feb. 1966
Obert N. Tufte Griffiss AFB, N. Y., RADC, May 1966 98 p refs
(Contract AF 30(602)-3672)
(RADC-TR-66-156; AD-633945) CFSTI: HC $3.00/MF $0.75

The purpose of this study was to investigate the feasibility of using impurity compensation techniques to lower the temperature coefficient of resistance of silicon diffused resistors. The effect of impurity compensation on the temperature dependence of the resistivity has been investigated in heavily doped n and p-type silicon. Compensation effects were first investigated in bulk doped compensated silicon, and the range of impurity concentrations and compensation ratios that produce changes in the temperature dependence of the resistivity were established. These results were then applied to the formation of compensated diffused resistors having improved

temperature coefficients of resistance. The temperature dependence of the resistance in silicon diffused resistors can be reduced to 2% over the range from −30°C to +125°C by compensation, however, a compensation ratio of approximately 50% is required and these effects occur only for carrier concentrations in the range from 8×10^{18} to 2×10^{19} cu/cm. Similar effects are found in both n and p-type silicon. In addition, it was found that using the optimum concentrations, the range of sheet resistance over which TCR improvement could be seen was 100 to 300 ohms per square. Author (TAB)

N66-33359# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.

THIN FILM TECHNIQUES FOR SILICON INTEGRATED CIRCUITS Quarterly Report No. 8, 1 Nov. 1965-31 Jan. 1966

L. E. Terry and F. Mancini May 1966 47 p

(Contract DA-28-043-AMC-00097(E))

(ECOM-00097-6; W-17; AD-633777) CFSTI: HC $2.00/MF $0.50

Resistance of electron beam evaporated cermet films was extended to 30,000 ohms/sq. Using the 30 percent Al_2O_3, 70 percent (TaSi and Cr_3Si powder, reproducibility of cermet deposition is being determined. Series of experiments on sputtered tantalum-silicon resistor films were initiated. Concentric circle 50-ohm resistors were fabricated for the ultrahigh frequency measurements experiments. Reactively sputtered Ta_2O_5 and SiN_2 capacitors to 1.5 pf/sq mil and 0.5 pf/sq mil, respectively. 1000 hour 200°C storage tests were completed on 100 IC892 resistor-transistor-capacitor units. IC772 circuit performance was reviewed using 200 ohms/sq and 2500 ohms/sq resistors. IC772 was redesigned to included coupling capacitor. Circular 50-ohm thin film resistor characteristics were measured up to 1000 MHz. Author (TAB)

N66-33370*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A UNIQUE VARIABLE WIDTH PULSE INTEGRATOR

Arthur L. Newcomb, Jr. [1964] 10 p Submitted for Publication

(NASA-TM-X-54847) CFSTI: HC $1.00/MF $0.50 CSCL 09A

Many servo-mechanisms employing sensing devices which produce pulses proportional in width to system rate and/or position. In these applications, tight system control is dependent on fast, accurate and reliable conversion of these pulses to a voltage which is proportional in magnitude to the width of the pulse. Accuracy of system control may also require an output which is relatively free of ripple components over a wide range of duty cycle. A circuit fulfilling these requirements has been developed and is presently being used in an infrared sensing spacecraft attitude sensor (horizon scanner) having a scan rate of about two per second. A pulse is developed at this repetition rate whose width is directly proportional to spacecraft attitude displacement from the local vertical. The duty cycle of this pulse ranges from 0.06% to about 60%. The spacecraft control system requires that the output furnish spacecraft rate in addition to position information. Author

N66-33390*# Battelle Memorial Inst., Columbus, Ohio.

ELECTRONIC PACKAGING: A BIBLIOGRAPHY

J. W. Klaphare, W. H. Veazie, J. C. Holt, and J. L. Easterday Redstone Arsenal, Ala., Redstone Sci. Inform. Center, 31 Mar. 1966 95 p refs Prepared for NASA

(Contract DA-01-021-AMC-11706(Z))

(NASA-CR-76570; RSIC-534) CFSTI: HC $3.00/MF $0.75 CSCL 09A

This annotated bibliography of selected reports, journal articles, and manufacturers' literature on electronic packaging provides a literature basis for electronic packaging engineers to design more reliable, maintainable, and adaptable electronic equipment for aerospace application. Subject indexing is provided by properties and environmental effects on packaging materials, discrete parts to module packaging, integrated circuits to module packaging, module packaging to assembly, housing and mounting, packaging products, and interconnection techniques. Author and corporate author indexes are included. Author

N66-33421*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

TANGENTIAL SENSITIVITY OF TUNNEL DIODE VIDEO DETECTORS

William F. Gabriel [1964] 14 p refs Presented at the 1965 G-MTT Symp., IEEE, Clearwater, Fla., 5-7 May 1965 Submitted for Publication

(NASA-TM-X-54862) CFSTI: HC $1.00/MF $0.50 CSCL 09A

Tunnel-diodes can be utilized as super-sensitive video detectors when biased in their negative resistance region such that they amplify the RF signal to be detected. An approximate equation has been derived for calculating the tangential sensitivity of tunnel diode video detectors on the basis of their equivalent circuit constants and the voltage-current characteristic. Calculated performance curves of tangential sensitivity vs. RF bandwidth are compared against measured data for the case of a single-tuned RF passband shape. The conditions covered include RF load variation, temperature variation, and frequency variation. For a given tangential sensitivity, the bandwidth will depend upon the type of passband response that is designed into the RF input circuit, and a comparison is shown between the single-tuned response and a double-tuned response detector. Author

N66-33479# North American Aviation, Inc., Columbus, Ohio.

OBSTRUCTION LIGHT SYSTEM Final Report

J. L. Conrad Apr. 1966 225 p

(Contract FAA-ARDS-647)

(NA65H-788; SRDS-RD-66-4; AD-634382) CFSTI: HC $6.00/MF $1.75

The report describes the design, development, and fabrication of a prototype high intensity obstruction lighting system. A detailed light source study was made which indicated a newly developed lamp consisting of a quart-iodide lamp sealed in a parabolic envelope, was the most advantageous type light source. The lamp was operated at less than rated current so that the life was extended to 10,000 hours on the specified operating cycle. In order to obtain the dimming required, the lamps were connected in a series and film disc cutouts were installed so that the burn out of one lamp would not stop current flow in the other lamps. A current regulator was used to maintain the current through the remaining lamps constant even after some lamp burn outs. The methods utilized in rotation and synchronization are discussed. A stepping motor is used for rotating and a light activated switch arrangement is used for synchronization. The test procedures and test report are included in the report. It is concluded that the light system meets the contract requirements and it is recommended that the F.A.A. accept the light system. Author (TAB)

N66-33483# General Electric Co., Auburn, N. Y. Semiconductor Products Div.

THE IMPROVEMENT OF PRODUCTION TECHNIQUES TO INCREASE THE RELIABILITY AND IMPROVE PRODUCT CAPABILITY OF HIGH VOLTAGE MINIATURE SILICON RECTIFIERS Quarterly Progress Report, 30 Dec. 1965-30 Mar. 1966

W. R. Comstock, P. C. Whitman, R. R. Schell, and E. C. Tefft [1966] 35 p refs

(Contract DA-36-039-AMC-06157(E))

(QPR-5; AD-634386) CFSTI: HC $2.00/MF $0.50

The work performed includes: A14 life test matrix, presentation of 500-hour life test summaries, and final device specification. TAB

N66-33582# Clevite Corp., Bedford, Ohio. Piezoelectric Div.
PRODUCTION ENGINEERING MEASURE FOR CERAMIC FILTERS Twelfth Quarterly Report, 30 Dec. 1965–24 Mar. 1966
A. Lungo [1966] 19 p
(Contract DA-36-039-AMC-01471(E))
(Rept.-12; AD-634049) CFSTI: HC $1.00/MF $0.50

During this period we have directed effort toward fabrication of the resonators required for the preproduction and pilot production filters. Also, a group of 6.0 Mc ceramic ladder filters were assembled and evaluated for the correlation of temperature dependency of the assembled filters' center frequencies to the frequency temperature characteristics of the resonators. Effort was also directed toward packaging 4.3 Mc and 6.0 Mc single resonator filters. Units were assembled, and the electrical characteristics which would be affected by the packaging were evaluated. Author (TAB)

09

N66-33583# New York Univ., N. Y. Lab. for Electroscience Research.
ON THE ANALYSIS OF COMPOSITE LUMPED-DISTRIBUTED SYSTEMS First Scientific Report
John J. Kelly, Mohammed S. Ghavsi, and James H. Mulligen, Jr. Mar. 1966 50 p refs *Its* Tech. Rept.-400-128
(Contract AF 19(628)-5537)
(AFCRL-66-278; AD-634064) CFSTI: HC $2.00/MF $0.50

Fabrication methods associated with modern microelectronic technology have stimulated detailed investigation of the properties of distributed active and passive transmission systems. As a consequence, there have appeared recently several interesting results concerning the analysis and synthesis of distributed networks. As one attempts to realize practical microelectronic systems, however, one confronts structures which require treatment as combinations of lumped and distributed networks. This report presents an analysis technique directly applicable to such composite configurations and gives examples of its application to several systems of current engineering interest. The technique is basically a generalization of root locus methods used in the analysis and synthesis of lumped systems. To permit applicability to composite lumped–distributed systems, one requires a generalization of the rules of construction applicable to systems with a countably infinite number of poles and zeros. In the report these rules are derived and their use is illustrated by several typical examples. Significant insight into the analysis and synthesis of composite lumped–distributed systems is obtained when use is made of the generalized root locus technique described in this report. Author (TAB)

N66-33585# Radio Corp. of America, Somerville, N. J.
THIN-FILM POLYCRYSTALLINE FIELD-EFFECT TRIODE Sixth Quarterly Report, 1 Oct.–31 Dec. 1965
J. J. Bowe, R. L. Schelhorn, F. V. Shallcross, A. S. Waxman, and P. K. Weimer Ft. Monmouth, N. J., Army Electron. Command May 1966 61 p refs *Its* Rept.-6
(Contract DA-28-043-AMC-00231(E))
(ECOM-00231-6; AD-634088) CFSTI: HC $3.00/MF $0.75

Capacitance measurements on CdS–SiO–Al structures at various well-controlled temperatures have indicated that the nature of the instabilities under applied bias can be irreversibly changed by heating the sample in vacuum from 25° to 50°C. Several mechanisms appear to be involved in these instabilities. Silica films deposited by resistance heating of SiO_2 are under study as encapsulants for M–I–S structures; refractive index data imply that the SiO_2 films are not completely stoichiometric. Photoemission of electrons into thin-film vapor-deposited insulators has been used to study the energy band diagram of thin-film vapor-deposited metal-insulator-semiconductor contacts and thin-film metal-insulator-metal contacts. The insulators studied to date have been SiO and SiO_2. We have found a barrier between SiO and Au of 3.6±0.15 eV and an energy barrier of 4.8±0.2 eV between SiO and CdSe. The photocurrent-voltage relationships of M–I–S structures and metal-insulator-metal structures are briefly discussed. Author (TAB)

09

N66-33588# Laboratory for Electronics, Inc., Boston, Mass. Solid State Electronics Lab.
ELECTRO-OPTICAL MATRIX DISPLAY Interim Development Report, 18 Dec. 1965–18 Mar. 1966
[1966] 14 p
(Contract NObsr-91199)
(IDR-480-Q6; AD-633780) CFSTI: HC $1.00/MF $0.50

Colloid lifetimes for sustained mobility have now exceeded six months in bench tests, and tests of units in actual display operation indicates that lifetimes can also be very long in functioning displays. The RIS films have been prepared on plastic substrates giving rise to the promise of all-plastic units which would greatly simplify the technology of sealing, and would drastically lower the price of display panels. A sealing technique involving all-glass units appears to show considerable promise of solving the glass-sealing problem. Panels for 4 in. × 8 in. display have been constructed, and illumination provided by means of incandescent and high pressure discharge lamps. Heat effects are the most serious problem in the current arrangement. The ac frequency has been found to be a non-critical factor in display switching, and curves have been obtained which show optimum choices for number of cycles of ac, and pulse current amplitudes. Author (TAB)

09

N66-33596# Ling Electronics, Anaheim, Calif.
DESIGN REPORT: 0 TO 25 KILOHERTZ 10 KILOWATT AMPLIFIER Final Technical Report, 30 Jun. 1965–24 May 1966
Colvin J. Bertrem 24 May 1966 48 p *Its* Rept.-42664
(Contract Nonr-4989(00))
(ER-169; AD-633570) CFSTI: HC $3.00/MF $0.75

The report covers the design of a high efficiency transistor amplifier. The amplifier power output is 10 kW over a frequency range of 0 to 25 kHz. Included is a study of the feasibility of using a high frequency carrier generated by an SCR inverter as an alternate method of high power broad band amplification. The possibility of a switching amplifier approach is also examined. Author (TAB)

09

N66-33610# Radio Corp. of America, Mountaintop, Pa.
PRODUCTION ENGINEERING MEASURE ON 2N3375 SILICON OVERLAY TRANSISTOR Fifth Quarterly Progress Report, 1 Jan.–31 Mar. 1966
F. Tumbelty and J. C. La Berge [1966] 16 p
(Contract DA-36-039-AMC-0364(E))
(Rept.-5; AD-634048) CFSTI: HC $1.00/MF $0.50

All processing investigations have been completed and the production runs were started early in February. The improvements and modifications in processing incorporated into the production run are: (1) bulk material improvement, (2) surface stability improvement, (3) metallization interface improvement, (4) improved photolithography, (5) improved wafer handling, and (6) hot spot detection. Author (TAB)

09

N66-33623# Army Electronics Lab., Fort Monmouth, N. J.
EVALUATION OF THE NUVISTOR TRIODE TYPE 8056
W. G. Muessle Apr. 1966 33 p
(ECOM-2700; AD-634089) CFSTI: HC $2.00/MF $0.50

The type 8056 nuvistor triode was evaluated to determine its capabilities for military application. Data are presented for static characteristics, power gain, noise figure, input admittance, cross modulation, and rf power output.
Author (TAB)

N66-33815# Frankford Arsenal, Philadelphia, Pa.
PHILOSOPHY OF ENVIRONMENTAL TESTING Final Report
David Askin Apr. 1966 36 p refs
(M66-21-1; AD-633577) CFSTI: HC $2.00/MF $0.50

This report discusses the philosophy of environmental testing, gives definitions of the more commonly used terms, classifies the various types of environmental tests, describes some effects of environmental stresses on military equipment and briefly discusses the derivation of environmental criteria and test standards. Author (TAB)

N66-33816# Bulova Watch Co., Woodside, N. Y. Electronics Div.
PRODUCTION ENGINEERING MEASURE FOR TYPE CR-(XM-60)/U CRYSTAL UNITS Quarterly Report, Oct.-Dec. 1965
G. A. Lagasse [1965] 24 p
(Contract DA-36-039-AMC-03633(E))
(QR-6; AD-633688) CFSTI: HC $1.00/MF $0.50

The new Kold-Weld holders were utilized in a 20 unit crystal group now under test. Evaluations will be made at the end of the test. Thermo-compression bonding had been abandoned early in the program in favor of ultrasonic welding. Efforts, however, will be resumed if ultrasonic welding does not prove practical. The re-evaluation of the reliability data uncovered some serious questions concerning the drive levels of the units under test. The CR-(XM-60)/U units to be manufactured are expected to have much lower resistance values than the present CR-47A/U units, because of process improvements including primarily, the evacuation of the Kold-Weld holders. Under these conditions, the drive levels may very well be in excess of five times the specification. A factor contributing to an increased aging rate, and perhaps, a poorer reliability rate than that of the CR-47A/U units. Author (TAB)

N66-33830# Philco Corp., Lansdale, Pa.
R AND D PROGRAM TO DESIGN AND FABRICATE DIGITAL MONOLITHIC MICROCIRCUITS HAVING AVERAGE PROPAGATION DELAY TIME OF 1 NS Quarterly Progress Report, 1 Jan.-31 Mar. 1966
[1966] 23 p Prepared for MIT
(Contract AF 19(625)-500)
(X-507; ESD-TR-66-210; AD-633615) CFSTI: HC $1.00/MF $0.50

The primary objective of this research and development program is the fabrication of silicon monolithic microcircuits with average propagation delay times in the subnanosecond region. A secondary objective of the program during the remaining quarterly period is to make preliminary investigation of the technological problems that relate to the fabrication of ultra-high-speed complex bipolar arrays. This investigation is directed toward predicting the improvements in speed that will be obtained in digital systems through the fabrication of many very-high-speed-monolithic circuits within a single chip. During this reporting period, primary program effort was applied in four main areas: refinement of the techniques required for the design and fabrication of high-speed npn silicon transistors and of digital micro-circuits of the saturating and unsaturating type with better speed-power properties; fabrication and evaluation of the SMX3, a high-speed microcircuit version of an npn ECL circuit used by Lincoln Laboratory; and evaluation of the circuit design and fabrication techniques required for the construction of a complex bipolar microcircuit array for 3-, 9-, and 27-bit versions of a parity generator. Author (TAB)

N66-33911# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Servizio Documentazione.
DYNAMIC BEHAVIOR OF TUNNEL DIODE MONOSTABLE CIRCUITS [COMPORTAMENTO DINAMICO DEI CIRCUITI MONOSTABILI A DIODE TUNNEL]
N. Abbattista, M. Coli, and V. L. Plantamura (Bari Univ.) 8 Mar. 1966 17 p refs In ITALIAN
(LNF-66/12)

The dynamic behavior of tunnel diode monostable circuits is analyzed as a function of a characteristic parameter of the circuit. The analysis was developed in a general way and the results were applied with regard to the problems of fast nuclear electronics. It is referred to the circuits with current gain greater than one and to the circuits performing only a logic operation, and is comparative between the circuits with linear and nonlinear biasing. The circuits with tunnel biasing very near to the peak were regarded for multiple switching stability that is the most important limit for high sensitivity monostable circuits. Author (NSA)

N66-33965# California Univ., Livermore. Lawrence Radiation Lab.
DESIGN FOR A VERSATILE CHARGE SENSITIVE PREAMPLIFIER FOR NUCLEAR RADIATION DETECTORS
Arne E. Bradley 19 Oct. 1965 30 p refs
(Contract W-7405-ENG-48)
(UCRL-1493-T, Rev.-1) CFSTI: HC $2.00/MF $0.50

The design of the high-gain, low-noise, charge-sensitive preamplifier is discussed. This transistorized preamplifier has good versatility without sacrificing performance characteristics. The maximum gain is about 650 volts/picocoulomb, but can be reduced by a factor of 1200. The noise figure is approximately 300 rms electrons (2.6 kev fwhm referred to a silicon detector) at zero input capacitance and 1-μs pulse shaping. Either polarity input signal is accepted with a maximum output of either $\pm$5 volts delivered to a 50-ohm load with better than 0.05% linearity. When desired, 1-μs integration and differentiation can be switch-selected to provide shaped pulses suitable for scalers or pulse height analyzers. Circuit design considerations to include frequency compensation, linearity, temperature stability, and bipolar operation are discussed. Graphs indicate preamplifier noise and rise-time performance characteristics. A brief analysis describes charge-loop performance in terms of circuit parameters. A modified version of the preamplifier, which has provisions for removing the FET from the chassis and cooling it to about 130°K, has yielded a zero-input-capacitance noise figure of approximately 140 rms electrons (0.95 kev germanium). Author (NSA)

N66-33962# Sandia Corp., Albuquerque, N. Mex.
A VOLTAGE-SAMPLING-ANALOG-TO-DIGITAL CONVERTER (FOR RECORDING NONRECURRENT PULSES)
May 1966 35 p
(Contract AT(29-1)-789)
(SC-DR-66-99) CFSTI: HC $2.00/MF $0.50

A single-channel voltage-sampling analog-to-digital converter was developed with the intent of continued development into a multipurpose n channel digitizer. The basic n channel digitizer was planned for use on a variety of types of waveforms, the user selecting the appropriate number of modules depending on his application. Information on the evolution of a practical implementation of modular hardware is included. A realizable design for sampling, conversion, storage, and read-out modules is described. Contributing factors to

the resultant absolute functional accuracy of this type of system are noted. They cause output readings to be in error by about ±1.0% to ±7.32% of full scale. In addition, inherent features which could be considered undesirable by some potential users are pointed out. Author (NSA)

N66-33987*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LOW POWER NANOSECOND PULSE AND LOGIC CIRCUITS USING TUNNEL DIODES
Stephen Paull, Ciro A. Cancro, and Norman M. Garrahan Washington, NASA, Aug. 1966 20 p
(NASA-TN-D-3558) CFSTI: HC $1.00/MF $0.50 CSCL 09A

A number of hybrid tunnel diode transistor pulse circuits have been developed to meet special requirements for cosmic ray experiments on scientific satellites and high-altitude balloons. These requirements include low power operation with pulse rise times as low as 50 nanoseconds, and compatibility for direct interconnection of threshold detectors, logic circuits, and commutating circuits without power-consuming amplifiers between stages. Circuit description and design information are given for five basic configurations: (1) threshold detector, (2) threshold detector and pulse stretcher, (3) single-pulse monostable, (4) double-pulse monostable, and (5) double-pulse monostable with feedback. Three functional combinations of these basic configurations are discussed to illustrate their compatibility for direct interconnection. They are (1) pulse width discriminator, (2) coincidence logic for particle detectors, and (3) pulse repetition frequency compressor. A basic microcircuit package is suggested, from which any one of the five basic configurations can be obtained by connecting appropriate shunts to external terminals. Author

N66-34025# Harry Diamond Labs., Washington, D. C.
SEMICONDUCTOR WAFER-BONDER
Robert J. Anstead Apr. 1966 14 p
(HDL-TM-66-4; AD-634030) CFSTI: HC $1.00/MF $0.50

A device for bonding semiconductor devices to headers is described. Individual dice are picked up from an indexing disc with a vacuum pencil and positioned over the header. The weight of the pencil serves as a pressure source on the transistor die while the heat is supplied through a filament heater. The bonding operation is carried out in a forming gas atmosphere. Construction of the instrument and operating procedures are described. Author (TAB)

N66-34031# General Instrument Corp., Darlington, S. C. Capacitor Div.
PRODUCTION ENGINEERING MEASURE FOR THE IMPROVED RELIABILITY OF CAPACITOR, FIXED, SOLID ELECTROLYTE, TANTALUM HIGH-RELIABILITY 100 MFD-20 VOLT CAPACITORS Quarterly Report, Jun. 29–Sep. 28, 1965
Floyd R. Banks, Jr. and A. Di Giacomo [1965] 21 p
(Contract DA-36-039-AMC-03622(E))
(QR-9; AD-632079) CFSTI: HC $1.00/MF $0.50

A concise statement is presented of the work performed during this reporting period. Combined process improvement studies reported include: (1) the conditions for the pre-pilot line test run; (2) anodizing and aging; (3) re-forming, carbon coatings, and aging; and (4) tantalum powder, binder, and aging. The design objectives of three dipping machines are described; they are for the manganous nitrate, colloidal graphite, and silver-paste dipping stages of the processing. These machines were developed independently of the contract but are now in use under the contract to incorporate into it the best state-of-the-art development. Similarly, new encapsulation fixtures have been designed and put into operation independetly of the contract; they, too, are under evaluation for the contract as part of the process improvement program. A formal reliability-oriented training program is discussed briefly. Technical conclusions are given along with the quarterly progress percentage calculations and the program for the next quarter. Author (TAB)

N66-34050# Bendix Corp., Davenport, Iowa. Pioneer-Central Div.
DESIGN AND DEVELOPMENT OF FREQUENCY TEMPERATURE COMPENSATED QUARTZ CRYSTAL OSCILLATOR O-1227( )/U Final Report, 1 Apr. 1964–30 Sep. 1965
[1965] 87 p refs *Its* Rept.-2
(Contract DA-28-043-AMC-00042(E))
(Publ.-3437-65; AD-634520) CFSTI: HC $3.00/MF $0.75

The need for ovenless quartz crystal oscillators having a deviation less than ±0.75 parts per million from an absolute frequency over all service conditions, including crystal aging, has been evident for modern communications systems. Knowledge derived from studies on frequency temperature compensation techniques indicated the feasibility of developing compensated oscillators providing a reduction in both required input power and size over conventional oscillator-oven assemblies. The object of Phase I of this program was to define and fabricate seven exploratory development oscillator models employing such compensation techniques to achieve a frequency stability of less than ±0.5 ppm over the temperature range of −40°C to +65°C. This effort was reported in the phase I interim report under this contract. After evaluation of these exploratory models, 18 advanced models were designed and fabricated under phase II of this program with the same stability over −40°C to +75°C. This report covers the effort expended and the results obtained during Phase II of this program. The discussion in this report is related to (1) description and test of the Phase II oscillators, (2) design considerations in formulation of Phase II design, (3) component standardization, and (4) overall conclusions and recommendations for this program. Author (TAB)

N66-34052# Tung-Sol Electric, Inc., Livingston, N. J. Chatham Electronics Div.
HIGH SPEED POWER AMPLIFIER USING AN ELECTRON SWITCHED P-N JUNCTION Interim Development Report, 27 Feb.–27 May 1966
Nelson E. Ake [1966] 20 p
(Contract NObsr-93306)
(QR-4; AD-633478) CFSTI: HC $1.00/MF $0.50

One of the latest design planar silicon dioxide passivated diodes has been fabricated into an EBM tube. The diode used in the tube has a reverse breakdown voltage of 900 volts measured at 300 μA. The reverse leakage current was 8 μA at 500 volts. The diode maintained its hard characteristics through sealing the heat sink to the envelope and sealing the electron gun to the glass envelope. However, after processing the diode appeared to be electrically shorted. After a current surge in the reverse direction the diode had a reverse voltage breakdown of 150 volts, and after standing over the weekend this voltage breakdown increased to 300 volts. It is planned to investigate further to try to determine the cause of this apparent deterioration during tube processing. Upon further processing of the gun cathode it was discovered that the heater was opened. The reason for this has not been determined and this tube will be dissected and examined after some further experimenting with the diode. Author (TAB)

N66-34053# Naval Research Lab., Washington, D. C.
EXPLORATION OF MULTI-ELEMENT BROADBAND TRANSDUCER Interim Report

R. V. Baier and M. A. Blizard 8 Mar. 1966 149 p
(NRL-MR-1691; AD-633786) CFSTI: HC $4.00/MF $1.00

The problem is defined as one whereby a broad band transducer is obtained by the use of many small elements, having normal values of mechanical Q, in an array. The technique employed here is one of selecting a set of dissimilar transducer elements and spatially arranging them throughout the array in various distributions. These distributions are selected on the basis of the individual air-resonant frequency of the elements. The behavior of this array, for several frequency distributions, with respect to the element's velocity, radiation load, radiated power, efficiency and transmitting response is presented. The results do indicate the possibility of designing a broad band transducer by multi-element array with some sacrifice in efficiency. Author (TAB)

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N66-32704*# Tennessee Univ., Knoxville. Dept. of Electrical Engineering.
MINIMUM ENERGY TIME-OPTIMAL CONTROL FOR SATURATING SAMPLED-DATA SYSTEMS
A. M. Revington and J. C. Hung 22 Oct. 1964 5 p refs
(Grant NsG-351)
(NASA-CR-59648) CFSTI: HC $1.00/MF $0.50 CSCL 09C

The paper considers the time-optimal regulator problem for sampled-data control systems with input saturation and minimal control energy. It is shown that of the infinite number of different control sequences that can, in general, give time-optimal control when the input is constrained by saturation, there is only one among them that also minimizes the control energy. A design procedure for both saturating and non-saturating systems is formulated from the theory and an example demonstrates the method. The example also brings out an interesting point when minimum fuel and minimum energy control sequences are compared. The method is restricted neither by the nature of the poles nor by the order of the system. Author

N66-32831# Gosudarstvennyi Komitet do Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Teoreticheskoi i Eksperimental'noi Fiziki.
THE OPTIMUM DISTRIBUTION OF CONTROL ELEMENTS [OPTIMAL'NOE RASPOLOZHENIE REGULYATOROV]
L. A. Myrtsymova and A. P. Rudik 1965 12 p refs In RUSSIAN; ENGLISH summary
(ITEF-402)

The Pontryagin's maximum principle is used to solve the optimum distribution of control elements problem. Author (NSA)

N66-32851# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
ANALYSIS AND SYNTHESIS OF THE SYSTEM FOR THE ELECTROMAGNET CURRENT STABILIZATION WITH THE AMPLIDYNE AS THE SOURCE OF CURRENT AND THE SELECTIVE FEEDBACK CIRCUIT IN THE LAST STAGE OF THE AMPLIFIER [ANALIZA I SYNTEZA UKLADU DO STABILIZACJI PRADU, ZASILAJACEGO ELEKTROMAGNES, Z AMPLIDYNA JAKO ZRODLEM PRADU ORAZ ODSPRZEZENIEM REZONANSOWYM W STOPNIU KONCOWYM WZMACNIACZA]
Zygmunt Burzynski 1965 77 p refs In POLISH; ENGLISH summary
(INR-639/3/E)

It is shown that the electromagnet current stabilization circuits with the amplidyne as the source of current and the chopper voltage error amplifier, need the synthesis for the used amplifications on the basis of the required stabilization. The synthesis depends on theoretical determination from the transmittance of corrected open circuit, the selective feedback parameters in the last stage of the amplifier, in order to receive the stabilized loop without essential reduction of the frequency band passed by the open circuit. The general form of the open system transfer function is given in the factored form. To simplify interpretation of logarithmic diagrams all factors are of first and second order. The Nyquist diagrams of circuit performance are given for the circuit before and after correction. Owing to very low sensitivity threshold and high amplification of the voltage error amplifier, determination of the amplitude-phase characteristics is made on the basis of input-output time oscillograms. Experimental Nyquist diagrams confirm validity of the theoretical synthesis. Oscillograms of the transient response for the closed system confirm efficiency of the selective feedback circuit in the last stage of the amplifier. On the basis of this theory of analysis and synthesis several current stabilizers for β spectrometers and magnetic analyzers were built in the Institute of Nuclear Research. Author (NSA)

N66-33128# Gt. Brit. Ministry of Aviation, London. Technical Information and Library Services.
STABILITY IN THE SOLUTIONS OF A NON-LINEAR SYSTEM OF THREE EQUATIONS [OB USTOICHIVOSTI V TSELOM RESHENII ODNOI NELINEINOI SISTEMY TREKH URAVNENII]
E. I. Zheleznov Jul. 1966 10 p refs Transl. into ENGLISH from Tr. Ural'sk. Politekhn. Inst. (Sverdlovsk, USSR), 1958 p 41-45
(TIL/T.5404) CFSTI: HC $1.00/MF $0.50

The three equations discussed are $\dot{x} = -Sx + ny$; $\dot{y} = -ax - cy - f(z)$; and $\dot{z} = x$. Previous work on these is reviewed and general conditions for the finite asymptotic stability of the trivial solution of the system are given. Author

N66-33133# Institut Franco-Allemand de Recherches, St. Louis (France).
MICROWAVE RESEARCH IN A MEMBRANE SHOCK WAVE TUBE [MIKROWELLEN-UNTERSUCHUNGEN AM MEMBRANSTOSSWELLENROHR]
B. Koch, M. Koenig, and H. Mech 21 May 1965 31 p refs In GERMAN
(ISL-T-15/65) CFSTI: HC $2.00/MF $0.50

Reported are velocity measurements on the ionizing front of argon shock waves traveling through a 10 cm diameter shock tunnel with membranes. The Doppler effect of an axially injected microwave ($\lambda = 3.2$ cm) reflecting from the ionizing shock wave front, was utilized as measurement technique. The resonance potential of the shock front was expressed as a function of the shock Mach number in the signal amplitude. Resonance factors obtained by this method were substantially lower than values deducted theoretically from a planar infinitely expanding, sharply defined plasma boundary layer. Comparison with calculations on an exponential electron density increase behind the shock front as performed by K. T. Yen established a reasonable relaxation time value to reach thermal equilibrium for the electron density. Author

N66-33179*# Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering.
ANALOG CIRCUIT FOR DETERMINING THE RATIO AND PRODUCT OF TWO TIME FUNCTIONS

D. H. Steinbrecher [1964] 4 p Presented at the Intern. Solid State Circuits Conv., Univ. of Pa., Philadelphia, 17–19 Feb. 1965
(Grant NsG-419; Contract DA-36-039-AMC-03200(E))
(NASA-CR-60083) CFSTI: HC $1.00/MF $0.50 CSCL 09A

The circuit utilizes the phase properties of a two-element RC bridge in which the "C" is an abrupt-junction varactor. Applications described: (1) universal automatic noise-figure meter; (2) ratiometer, both of which are stable and accurate. Author

N66-33242# Johns Hopkins Univ., Baltimore, Md. Dept. of Mechanics.
OSCILLATIONS IN A CLASS OF MULTILOOP SYSTEMS CONTAINING TWO NONLINEARITIES
Lawrence P. Grayson Apr. 1966 30 p refs
(Contract AF 49(638)-496)
(AFOSR-SR-66-0621; AD-633975) CFSTI: HC $2.00/MF $0.50

This paper presents a procedure for the analysis of a class of multiloop nonlinear systems containing two nonlinearities. The approach treats the effects of the linear and nonlinear elements separately, with the result that stability can be determined and limit cycles predicted from the open-loop frequency response data of the individual components. The technique is graphical and allows simple design to be performed. An example is given; limit cycles are predicted and compared with the results of computer simulation. Author (TAB)

N66-33255# Naval Research Lab., Washington, D. C.
EXPLODING WIRE RESEARCH, 1774–1963
J. R. Mc Grath May 1966 19 p refs
(NRL-MR-1698; AD-633623) CFSTI: HC $1.00/MF $0.50

A review of exploding wire phenomena (EWP) research is presented. This review covers the work performed from 1774 to the most current publication. Representative and significant studies are cited to indicate the difficulties associated with EWP research and the recent progress made in overcoming them.
Author (TAB)

N66-33293# Illinois Univ., Urbana. Coordinated Science Lab.
ON THE GENERATION OF DIAGNOSTIC TEST PROCEDURES
Wendell J. Bouknight May 1966 66 p refs
(Contract DA-28-043-AMC-00073(E); Grant NSF GK-36)
(R-292; AD-633594) CFSTI: HC $3.00/MF $0.75

The problem of generating diagnostic test procedures for combinational logic networks is studied and an algorithm developed that generates test procedures in a form ready to use by a test engineer. The method used to select the input vectors of the test sequence is to choose the best inputs that partition the failures of the network into either single member distinguishable failure classes or indistinguishable failure classes that are distinguishable from the rest of the failures of the network. All knowledge about the behavior of the network is derived from the output results of the test procedures. The algorithm simulates the network to derive the procedures on this basis.
Author (TAB)

N66-33383*# Rice Univ., Houston, Tex. Dept. of Electrical Engineering.
MODIFIED TECHNIQUE FOR MEASURING DIELECTRIC CONSTANTS USING A RECTANGULAR CAVITY RESONATOR
J. R. Sinha [1962] 52 p refs
(Grant NsG-6)
(NASA-CR-77002) CFSTI: HC $3.00/MF $0.50 CSCL 09C

A modified technique using a partially filled rectangular cavity-resonator is described. This technique is analogous to a former technique in which a partially filled tunable cylindrical cavity resonator is employed. The theory and the method of operation of this technique are discussed and the special advantages resulting from its use are pointed out. Author

N66-33435*# Westinghouse Electric Corp., Baltimore, Md. Surface Div.*
RESEARCH ON FAILURE FREE SYSTEMS Quarterly Report No. 8, Mar. 23–Jun. 23, 1966
[1966] 12 p ref
(Contract NASw-572)
(NASA-CR-77054; WGD-38531) CFSTI: HC $1.00/MF $0.50 CSCL 09A

Research is being conducted to develop new techniques for increasing the reliability of vital electronic systems. The status and technical activities performed during this period on the current phase of the program are described. This phase provides for the documentation of a computer simulation program to perform reliability analyses of a wide variety of failure responsive redundant systems, and the development of computerized procedures for efficiently allocating a limited number of test points within a redundant system and for estimating the system reliability when one or more components may have failed at the time of estimation. R.N.A.

N66-33441*# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
MINIMAX CONTROLS OF UNCERTAIN SYSTEMS
Hans S. Witsenhausen May 1966 184 p refs
(Grant NsG-496)
(NASA-CR-77050; ESL-R-269) CFSTI: HC $5.00/MF $1.25 CSCL 09B

The control of uncertain systems is considered as a decision problem. Some general concepts, such as adaptivity, are analyzed in this light and features common to many design methods are clarified. The special case of worst-case, or minimax design, is considered in more detail. The dynamic programming algorithm is discussed for a class of linear problems with bounded perturbations, bounded control variables, and with sampled output of the state. A dual algorithm using the support functions of reachable sets is proposed. Bounds are obtained, relating the performance of optimal and suboptimal designs, when the criteria have the properties of norms. Author

N66-33455*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
USE OF PHASE-LOCKED-LOOP CONTROL FOR DRIVING ULTRASONIC TRANSDUCERS
L. Jack Smith Washington, NASA, Aug. 1966 10 p refs
(NASA-TN-D-3567) CFSTI: HC $1.00/MF $0.50 CSCL 09C

The method of phase-locked loop was adapted for use as a frequency-control system for an ultrasonic transducer. This method provides better control over a greater resonant-frequency deviation than was provided by the previous proportional-control methods. Improved frequency control creates a more constant oscillation amplitude. The phase-locked-loop control of ultrasonic transducers is compared with the self-resonant and the proportional-control systems. Experimental results on a 600-W magnetostrictive transducer show the frequency-control accuracy to be ±0.5 H over a resonant-frequency deviation of 800 H from an initial resonant frequency of 25 cHz. The amplitude remained constant to within 5 percent of that at resonance. Author

N66-33458*# General Precision, Inc., Little Falls, N. J.
STUDY OF QUASI-OPTIMUM FEEDBACK CONTROL TECHNIQUES
Bernard Friedland, Frederick E. Thau, Victor D. Cohen, and Jordan Ellis Washington, NASA, Aug. 1966 96 p refs
(Contract NAS2-2648)
(NASA-CR-527) CFSTI: HC $3.00/MF $0.75 CSCL 17G

A quasi-optimum control technique for design of feedback control systems, which employs the modern variational approach but does not entail the solution of a complex two-point boundary-value problem, is presented. The technique is based on the observation that a complex process can often be approximated by a simpler process for which the exact optimum feedback control law can be expressed in closed-form. The technique is related to the so-called second-variation technique except that linearization is performed with respect to a simplified process rather than a nominal trajectory of the exact process, and the correction is made to the adjoint vector rather than directly to the control variable. Various examples and applications of the technique are considered including a minimum-time constant-thrust rendezvous in free space, flight control of a flexible booster, minimum-time three-axis attitude control of a space vehicle with small but not negligible gyroscopic cross-axis coupling, and guidance of a maneuverable reentry vehicle. S.P.

N66-33470# Air Force Systems Command, Kirtland AFB, N. Mex. Air Force Weapons Lab.
CURRENTS INDUCED IN CABLES IN THE EARTH BY A CONTINUOUS-WAVE ELECTROMAGNETIC FIELD Technical Report, Jan. 1964–Jun. 1965
Donald R. Marston and William R. Graham May 1966 112 p refs
(AFWL-TR-65-94; AD-634740) CFSTI: HC $4.00/MF $0.75

The problem under examination is the determination of the currents induced by a distributed continuous-wave electromagnetic field in a conducting wire buried in the earth. Transmission line theory is shown to provide a suitable approximation for studying this problem. A program for machine computation, utilizing this theory, was written to calculate the induced current. The special cases examined are: a bare wire with open circuit terminations, an insulated wire with either open circuit terminations or grounded terminations, and a wire encased in a high-conductivity coating with open circuit terminations. The theoretical calculations are compared with experimental results obtained by Stanford Research Institute. The comparison of the theoretical and experimental results indicates that predictions of practical value can be made by using the transmission-line model. Author (TAB)

N66-33476# Illinois Univ., Urbana. Coordinated Science Lab.
A CAPACITIVELY COUPLED BISTABLE GAS DISCHARGE CELL FOR COMPUTER CONTROLLED DISPLAYS
Robert H. Willson Jun. 1966 74 p refs
(Contracts DA-28-043-AMC-00073(E); Nonr-3985(08))
(R-303; AD-634794) CFSTI: HC $3.00/MF $0.75

The capacitively coupled gas cell is made from a sandwich of three thin glass panels. A hole in the center panel forms the discharge cell and transparent electrodes on the outer surfaces of the outer panels are capacitively coupled into the cell. A simple model of the cell consisting of three capacitors and a spark gap is used to explain the bistable characteristic of the cell and the inherent electrical isolation between cells. The ratio of the firing voltage to the sustaining voltages (the voltage at which the cell refires each half cycle after the cell is first fired) was measured for a number of cells with different pressures. It is suggested that photon bombardment of the negative surface controls the rapid discharge while, in the slower discharge, ion bombardment of the negative surface controls the discharge. Data is given for a variety of gases and gas mixtures. Switching arrays for coincidently selecting a row and a column of an array of cells are also discussed. Author

N66-33477# Cornell Univ., Ithaca, N. Y. School of Electrical Engineering.
INVESTIGATIONS OF LINEAR BEAM AND NEW CONCEPTS OF MICROWAVE POWER GENERATION, VOLUME I Final Report, 1 Oct. 1963–30 Sep. 1965
Griffiss AFB, N. Y., RADC, May 1966 175 p refs
(Contract AF 30(602)-3243)
(RADC-TR-66-62, Vol. I; AD-634129) CFSTI: HC $5.00/MF $1.00

This report includes studies on (1) the interaction of magnetically focused electron beams with electromagnetic circuits, (2) basic electromagnetic interaction circuits, (3) electron beam phenomena, (4) an electron-beam plasma amplifier, (5) laser-stimulated emission, and (6) bulk microwave solid-state electronic devices. Author (TAB)

N66-33478# Cornell Univ., Ithaca, N. Y. School of Electrical Engineering.
INVESTIGATIONS OF LINEAR BEAM AND NEW CONCEPTS OF MICROWAVE POWER GENERATION, VOLUME II Final Report, 1 Oct. 1963–30 Sep. 1965
Griffiss AFB, N. Y., RADC, May 1966 277 p refs For abstract see N66-33477 19-10
(Contract AF 30(602)-3243)
(RADC-TR-66-62, Vol. II; AD-634130) CFSTI: HC $6.00/MF $1.50

This report includes studies on (1) the interaction of magnetically focused electron beams with electromagnetic circuits, (2) basic electromagnetic interaction circuits, (3) electron beam phenomena, (4) an electron-beam plasma amplifier, (5) laser-stimulated emission, and (6) bulk microwave solid-state electronic devices. Author (TAB)

N66-33507# Illinois Univ., Urbana. Coordinated Science Lab.
ALGEBRAIC GENERATION AND ACTIVE NETWORK REALIZATION OF STATE EQUATIONS
Gert O. Martens May 1966 63 p refs
(Contract DA-28-043-AMC-00073(E))
(R-294; AD-634272) CFSTI: HC $3.00/MF $0.75

A characterization is given for the state equations of an RLC network with sources. It is shown that the coefficient matrix of the state equations must be representable as a product of two factors satisfying necessary symmetry conditions. Each factor must be realizable as the input–output matrix of a resistive network. It is also shown that, except for degenerate cases, an input–output matrix singular as well as non-singular must satisfy a divisibility property. The divisibility property is then utilized to insert variables to generate a near-primitive hybrid matrix from an input–output matrix. This process is algebraic and does not require the factoring of polynomials. The near-primitive hybrid matrix determines a positive definite diagonal matrix and a hybrid matrix which, after the permutation of submatrices, yield the required product representation for the coefficient matrix of the state equations. The characteristic polynomial of the A matrix is identical with the minimal polynomial of A and the monic common denominator of the input–output matrix. Active RC and active RLC network realizations for time-varying as well as time-invariant linear state equations are obtained. Thus it is shown that any linear system, time-varying the time-invariant, can be simulated by an active network. Author (TAB)

N66-33650# Lincoln Lab., Mass. Inst. of Tech., Lexington.
LAGUERRE FUNCTIONS AND THE LAGUERRE NETWORK—THEIR PROPERTIES AND DIGITAL SIMULATION
Charles R. Arnold 4 May 1966 46 p refs
(Contract AF 19(628)-5167)
(TN-1966-28; ESD-TR-66-202; AD-633609) CFSTI: HC $2.00/MF $0.50

This report summarizes the properties of the Laguerre polynomials, the Laguerre functions, and the Laguerre network. Their relationship to system theory is indicated and some typical results from a digital simulation are presented. The theory for the corresponding discrete-time network used for the simulation is developed within the report. Author (TAB)

N66-33655# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INTRODUCTION TO CYBERNETICS
V. M. Glushkov 17 Feb. 1966 475 p Transl. into ENGLISH of the book "Vvedeniye v Kibernetiku" Kiev, Akad. Nauk Ukr. SSR, 1964
(FTD-TT-65-942/1+2; AD-633642) CFSTI: HC $7.75/MF $2.00

This book contains the collected and unified material necessary for the presentation of such branches of modern cybernetics as the theory of electronic digital computers, theory of discrete automata, theory of discrete self-organizing systems, automation of thought processes, theory of image recognition, etc. Discussions are given of the fundamentals of the theory of Boolean functions, algorithm theory, principles of the design of electronic digital computers and universal algorithmical languages, fundamentals of perceptron theory, some theoretical questions of the theory of self-organizing systems. Many fundamental results in mathematical logic and algorithm theory are presented in summary form, without detailed proofs, and in some cases without any proof. The book is intended for a broad audience of mathematicians and scientists of many specialties who wish to acquaint themselves with the problems of modern cybernetics. Author (TAB)

N66-33808# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STEADY-STATE REGIMES IN LINEAR AND NONLINEAR CIRCUITS
I. Ye. Sredniy 23 Feb. 1966 161 p refs Transl. into ENGLISH of the book "Statsionarnyye Rezhimy v Lineynykh Tsepyakh (Impul'chyy Analiz)" Kiev, Gos. Izd. Tekhn. Lit., 1963 168 p
(FTD-TT-65-1556/1+2; TT-66-61389; AD-633608) CFSTI: HC $5.00/MF $1.00

This book presents a new method for the pulse analysis of oscillations which is based on the expansion of periodic functions into functional-power series. The method is used for the description of stationary regimes in linear and nonlinear circuits. Primary attention is devoted to determination of the response of the system to a discontinuous-periodic input. The book includes the solution of several problems in pulse engineering and self-oscillation theory. The book is intended for engineers and technicians working with pulse techniques and may also be of use to the students of advanced courses in electronics. Author (TAB)

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N66-32706*# National Aeronautics and Space Administration, John F. Kennedy Space Center, Cocoa Beach, Fla.
STUDIES PROGRAM SYMPOSIUM
1 Jun. 1965 159 p
(NASA-TM-X-56828; SP-190-D) CFSTI: HC $5.00/MF $1.00 CSCL 22D

Continuing research and development on space flight technology, and Saturn IB and V ground, orbital, and lunar launch operations are discussed. Advanced planning on a broad spectrum of related areas is outlined, and two typical candidate vehicles are sketched. Also considered briefly are: the integral umbilical concept, strap-on configuration, gaseous and liquid helium transportation costs, high-pressure, large flow rate connector system, radiation from exhaust plumes, vehicle performance gains with fluorine, and fluorine–oxygen (FLOX) oxidizers, ballistic logistic vehicles for space station support, the transmitting of information by optical electronics (TIBOE) project, and panel displays by optical projection. Schematics complement the data. R.Li.

N66-32788*# Physics International Co., San Leandro, Calif.
THE DEVELOPMENT OF AN EXPLOSIVELY DRIVEN HYPERVELOCITY GAS GUN Final Report
E. T. Moore and C. S. Godfrey 18 Aug. 1965 75 p refs
(Contract NASw-978)
(NASA-CR-76941; PIFR-132) CFSTI: HC $2.50/MF $0.75 CSCL 14B

A conical hypervelocity gun was developed, and successfully accelerated intact projectiles to 4.15 km/sec. Projectile fragments were accelerated to velocities of approximately 12.2 km/sec. Concurrently, a linear hypervelocity gun was developed to systematically investigate launcher geometries, acceleration levels, projectile materials, and light gases to be used ultimately in the higher-performance conical guns. The linear gun accelerated intact projectiles to 7.92 km/sec and broken projectiles to 8.33 km/sec. Author

N66-32852# Sandia Corp., Albuquerque, N. Mex.
ORGANIZATION AND MANAGEMENT OF A STANDARDS AND CALIBRATION PROGRAM FOR A RESEARCH AND DEVELOPMENT LABORATORY
R. L. Schneider Apr. 1966 10 p Presented at the Natl. Conf. of Std. Labs., Ann. Meeting, Gaithersburg, Md.
(Contract AT(29-1)-789)
(SC-DC-66-1491; CONF-660522-1) CFSTI: HC $1.00/MF $0.50

A measurement standards and instrument calibration program for a research and development laboratory is described. The description of this program deals primarily with the organizational philosophy of the system and does not delve into the technical aspects of standards or instrument calibration. NSA

N66-32980*# Texaco Experiment, Inc., Richmond, Va.
LUNAR GEOPHYSICAL SURFACE AND SUBSURFACE PROBES FOR APOLLO APPLICATIONS PROGRAM: VOLUME I: DETAILED TECHNICAL REPORT Final Report

R. H. Clinard, Jr. 27 May 1966 516 p refs
(Contract NAS8-20085)
(NASA-CR-76721; EXP-452, Vol. I; TP-277, Vol. I) CFSTI: HC $4.66/MF $2.50 CSCL 22A

A study has been carried out to determine the optimum integrated instrument probes to be used for manned lunar exploration with the Apollo Applications Program. A lunar probes system is recommended consisting of: an optimum subsurface probe, a subsurface neutron–gamma probe, a subsurface television probe, an integrated surface probe, a supporting electronics package, a deployment and cable assembly, and an acoustic source holder. This system is described in detail with the justifications, instruments characteristics, and operations requirement of the selected experiments given. Information is also included on experiments considered in the study, which do not appear in the recommended system. Author

N66-32961*# Texaco Experiment, Inc., Richmond, Va.
LUNAR SURFACE AND SUBSURFACE PROBES FOR APOLLO APPLICATIONS PROGRAM. VOLUME II: SUMMARY TECHNICAL REPORT Final Report
R. H. Clinard, Jr. 27 May 1966 109 p
(Contract NAS8-20085)
(NASA-CR-76720; EXP-462, Vol. II; TP-277, Vol. II) CFSTI: HC $3.00/MF $0.75 CSCL 22A

A lunar probes system is recommended that consists of: an optimum subsurface probe, a subsurface neutron–gamma probe, a subsurface television probe, an integrated surface probe, a supporting electronics package, a deployment and cable assembly, and an acoustic source holder. This system is described in detail, including the justifications, instrument characteristics, and operational requirements of the selected experiments. A listing is also included of experiments considered in the study which do not appear in the recommended system. Non-functional mockup hardware of the recommended probes was constructed and submitted to NASA for use in system integration studies and time-and-motion-study testing. Author

N66-33217# Cincinnati Univ., Ohio.
RESEARCH AND EXPERIMENTATION ON UNIQUE EXPANDABLE SHELTER CONCEPTS FOR LIMITED WAR APPLICATIONS Final Technical Report, 23 Dec. 1963–4 Sep. 1965
James M. Alexander and Karl H. Merkel Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Dec. 1965 143 p refs
(Contract AF 33(615)-1285)
(AFAPL-TR-65-116; AD-630635) CFSTI: HC $4.00/MF $1.00

Lightweight expandable shelters for limited war applications are described. Concepts for both small (16 ft wide) and large (50 ft wide) shelters are presented. Included in the small shelter section is the development of several different geometric configurations and methods of assembly. The construction, testing, and erection of prototype shelters based on two of the concepts are covered. Both shelters described utilize plastic foamboard as the basic construction material. Data on static load tests, erection time, package cubage, and package weight are included. Several structural concepts for the large shelter are presented. This structure, designed to serve as a hangar for a fighter aircraft, is carried through the concept stage only. The various concepts are described and sketches illustrating their key features are presented. Author (TAB)

N66-33248# RAND Corp., Santa Monica, Calif.
ASTRONOMY FROM THE MOON: A LOGISTIC APPRAISAL
R. C. Moore and G. F. Schilling Jun. 1966 11 p refs
(P-3377; AD-633953) CFSTI: HC $1.00/MF $0.50

A methodology is available for quantitatively evaluating the implications of superimposing scientific requirements on an existing or planned supply support system for space operations. For one application, a detailed scenario was prepared for an astronomical research program that culminates in the establishment of a lunar-based observatory. The scientific requirements of this scenario were then added to the basic requirements for the construction and operation of a manned lunar base over an eight-year period. The numerical results indicate that such a research program is logistically feasible and could be conducted during the next decades. Further analysis suggests that future scientific space missions, in other disciplines as well as in astronomy, can fruitfully be planned in terms of weights and dimensions orders of magnitude larger than those of today. Author (TAB)

N66-33275# ARO, Inc., Arnold Air Force Station, Tenn.
EXPERIMENTAL INVESTIGATION OF STAGED PUMPING TECHNIQUES FOR THE REMOVAL OF ROCKET EXHAUST GASES FROM SPACE SIMULATION CHAMBERS
W. G. Kirby and B. A. Mc Cullough Arnold Eng. Develop. Center, Jun. 1966 50 p refs
(Contract AF 49(600)-1200)
(AEDC-TR-66-51; AD-633471) CFSTI: HC $2.00/MF $0.50

Results of an experimental investigation conducted to determine the feasibility of using titanium gettering to remove large flows of H_2 gas and of combining gettering and cryopumping in a staged pumping system to remove simulated rocket exhaust gases are presented. The staged pumping system (about 8 in. in diameter and less than 30 in. long) consisted of a 77K cryopumping stage, a 20K cryopumping stage, and a titanium gettering stage with 77K surfaces. High temperature combustion exhaust gas mixtures, with flow rates up to about 0.3 gm/sec, were pumped, and a pressure level of about 0.001 torr was maintained. Author (TAB)

N66-33357# ARO, Inc., Arnold Air Force Station, Tenn.
A THEORETICAL REAL-GAS ANALYSIS OF THE EXPANSION TUNNEL
Glenn D. Norfleet and F. C. Loper Arnold Eng. Develop. Center, Jun. 1966 81 p refs
(Contract AF 40(600)-1200)
(AEDC-TR-66-71; AD-633656) CFSTI: HC $3.00/MF $0.75

A theoretical real-gas analysis of the expansion tunnel is presented. A digital computer program, developed for this investigation, is discussed and Fortran listings and flow charts are included. Tunnel performance, test gas slug length, and 'working' parameters are given for several expansion area ratios. Driver temperature and energy requirements are given for specific cases. Author (TAB)

N66-33360# ARO, Inc., Arnold Air Force Station, Tenn.
AN INTENSITY AND UNIFORMITY MONITOR FOR SOLAR SIMULATORS
B. A. Mc Cullough, B. E. Wood, J. P. Dawson and R. C. Birkebak (Ga. Inst. of Tech.) Arnold Eng. Develop. Center, Jun. 1966 27 p refs
(Contract AF 40(600)-1200)
(AEDC-TR-66-81; AD-633622) CFSTI: HC $1.00/MF $0.50

An experimental study of a portable intensity and uniformity monitor for solar simulators is presented. The monitor is a modified integrating sphere coated with MgO and utilizes a thermopile as the detector. The radiation wavelengths used in

evaluating the monitor were generated by a carbon arc solar simulator. These data were obtained as a function of time, intensity, temperature, and uniformity. The theory and operation of the monitor employed in these experiments are discussed. A modification of this monitor for use as a reflectometer is also presented. Author (TAB)

N66-33398* Michigan Univ., Ann Arbor. Inst. for Social Research.

CONTACTS WITH COLLEAGUES AND SCIENTIFIC PERFORMANCE

Frank M. Andrews 1 Jun. 1966 30 p refs Submitted for Publication

(Grant NsG-498)

(NASA-CR-77013) CFSTI: HC $2.00/MF $0.50 CSCL 14B

Contacts between people in laboratory organizations were investigated to determine some environmental factors which might stimulate scientific productivity. To this end, a specially-prepared questionnaire was administered to hundreds of scientists and engineers in 11 diverse American laboratories, and a similar questionnaire was devised for use in three British industrial laboratories. In both questionnaires "colleagues" were defined as other professionals, both subordinate and superior, with whom a scientist worked. In addition to the results from the questionnaires, performance ratings were obtained from both peers and superiors. Among the sociological factors considered, contact with colleagues seemed to be the one which most stimulated technical performance. There appeared to be several different paths to effective interaction, but contact with many people is most important. M.W.R.

N66-33424*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

VARIABLE DYNAMIC FORCE VECTOR ROCKET TEST APPARATUS

Melyin H. Lucy, Robert L. Swain, and John L. Hudson, Jr. [1964] 11 p Presented at the 2d Ann. Meeting of the ICRPC Working Group on Static Testing, Redlands, Calif., 21–23 Oct. 1964

(NASA-TM-X-54895) CFSTI: HC $1.00/MF $0.50 CSCL 14B

To systematically study and evaluate the effects of dynamic motor environments on the performance characteristics of solid rockets, a special test apparatus capable of imposing variable conditions of roll and/or longitudinal accelerations on solid rockets while firing was installed. This dynamic force vector rocket test apparatus employs the centrifugal principle utilizing a 4-foot-radius rotating arm which will produce up to 30,000g pounds with a 100-pound rocket motor specimen. Within the rotating arm is a separately driven spin shaft capable of simultaneously rolling the test specimen about its longitudinal axis at rates up to 3000 rpm. Individual controls are provided for the rotating arm and the spin shaft which are both electrically driven and separately adjustable and variable over their entire range. Test specimen instrumentation is provided through the use of double slipring assemblies. The test specimen can be counterbalanced through a weight system prior to each test as required but the apparatus is designed to withstand the full unbalance which could result from loss of specimen. This paper presents the design details of this specialized rocket test apparatus and its performance characteristics obtained to date. Author

N66-33545 Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.

RESEARCH OF AN INTENSE PROTON SOURCE PULSED IN A MICRO-SECOND [RECHERCHE D'UNE INTENSE SOURCE DE PROTONS PULSEE A LA MICRO-SECONDE]

Jean-Loup Belmont (Ph.D. Thesis) 1965 39 p refs In FRENCH

(CEA-R-2802; PB-169234) CFSTI: HC $2.00/MF $0.50

A study was undertaken to obtain a functionally stable proton source with a minimum of 50 milliamperes pulses per microsecond and with a current of at least 500 microamperes. Possible pulsation systems were examined, and a duoplasmatron source was obtained which did not meet the necessary requirements except for use with an oxide filament bombarded by ions. It was determined that this source could be pulsed in the same way as one from a thyratron, and an adequate duoplasmatron source was obtained which is functionally stable and easily used. This source results in a pile of more than 100 milliamperes of ions, of which 60 to 95% are protons.

Transl. by M.W.R.

N66-33562# Douglas United Nuclear, Inc., Richland, Wash.

AN EXPERIMENTAL, CONTINUOUSLY REGENERATED, ELECTROLESS NICKEL PLATING FACILITY

G. F. Jacky 2 Jun. 1966 40 p refs

(Contract AT(45-1)-1857)

(DUN-800) CFSTI: HC $2.00/MF $0.50

The electroless nickel plating process can be readily conducted in stainless steel equipment with suitable electrolytic passivation. High quality, adherent plate can be deposited up to a bath age of 1.4 ft^2 mils of nickel deposited per gallon of bath without interference from reaction products or trace metallic impurities. The process was based on an acid-type, lactate-buffered plating bath with sodium hypophosphite as the reducing agent. Major equipment items included a plating tank, a cooler tank, a chemical addition system, a recirculation pump, filters, and a solution heater. Heating equipment was designed to minimize the temperature of the heating surfaces; 15 psig steam was used as a heating medium. Instrumentation included automatic control of plating solution temperatures, recirculation rate, and chemical composition. Chemical composition was controlled by continous pH measurement, with metered addition of concentrated solutions of nickel sulfate, sodium hypophosphite, and sodium hydroxide. Stainless steel surfaces were continuously passivated (to avoid deposition of plate) by making them anodic with a direct current of approximately 0.04 A/ft^2. Organic materials for packing and gasketing the system must be carefully selected, since the presence of organics in the plating bath may result in grossly poor plate adhesion and/or discoloration. In process studies, plate deposition rate was controlled to 0.5 ± 0.05 mil/hr, with major factors being bath temperature and pH. Plate thickness was controlled between 0.12 and 0.25 mil in plating over 500 ft^2. NSA

N66-33717*# Hamilton Standard Div., United Aircraft Corp., Windsor Locks, Conn.

AN ENGINEERING STUDY AND PRELIMINARY DESIGN OF A ONE MAN PROPULSION DEVICE FOR LUNAR AND FREE-SPACE ENVIRONMENTS Mid-Point Oral Status Report

20 Jan. 1964 57 p

(Contract NAS9-2065)

(NASA-CR-65441) CFSTI: HC $2.50/MF $0.50 CSCL 05E

An oral report brochure on lunar surface and free space locomotion using a one man propulsion device is presented. Data are shown on lunar surface and free space operations, piloting and control, propulsion device concepts, propulsion in the lunar gravity field and zero-gravity, navigation, and various system missions. Diagrams and photographs of propulsion system models are included. A.G.O.

N66-33773# Centre National de la Recherche Scientifique, Meudon (France). Lab. d'Aerothermique.

THE SH3 HYPERSONIC WIND TUNNEL OF THE LABORATOIRE D'AEROTHERMIQUE OF C.N.R.S. [LA SOUFFLERIE HYPERSONIQUE SH3 DU LABORATOIRE D'AEROTHERMIQUE DU C.N.R.S.]

Jean Allegre, Christian Bisch, and Dietrich Faulmann Jun. 1966 36 p refs In FRENCH; ENGLISH summary *Its* Rept.-66-4

(Publ.-272) CFSTI: HC $2.00/MF $0.50

This paper gives some indications concerning the facility design and some preliminary measurements in the first French hypersonic wind tunnel operating continuously at Mach numbers between 16 and 19. Nitrogen, the working gas, is heated through a graphite resistance heater up to 2000°K; stagnation pressures required are up to 3000 psia. Operating capabilities, technical details and some aerodynamic performances are described in the report. Author

N66-33885*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.

ELECTRICAL REFERENCE HANDBOOK, LAUNCH EQUIPMENT BRANCH ELECTRICAL SUPPORT EQUIPMENT LC-39, VOLUME I

1 Nov. 1965 371 p Revised

(NASA-TM-X-57822; SP-166-D) CFSTI: HC $7.00/MF $1.75 CSCL 22D

A handbook is presented that describes the Electrical Support Equipment (ESE) for launch complex 39. This equipment includes the electrical subsystems which provide control, test, and monitoring of the service arms, command module access arm, tail service masts, pneumatic distribution panels, hydraulic charging and supply units, engine servicing platforms, Q-ball cover removal mechanism, and oxygen conditioning system. The ESE is described as an overall integrated system, and again as individual panels and cabinets. C.T.C.

N66-33918# Atomic Energy Commission, Idaho Falls, Idaho. Health and Safety Div.

CRITERIA FOR HIGH EFFICIENCY FILTER INSTALLATIONS AT THE NATIONAL REACTOR TESTING STATION

John T. Collins, Jr. 15 Dec. 1965 59 p refs

(IDO-12045) CFSTI: HC $3.00/MF $0.75

General criteria for determining the need for high efficiency filters, design of filter enclosures, and specifications for fire resistive filters are given. Procedures for handling, inspecting, and storage of high efficiency filters together with procedures for installation, maintenance, and in-place testing of high efficiency filters and filter systems are outlined. The basic criteria for design of new facilities and modifications as outlined in the ID Engineering Standards are supplemented by elaborating on specifications for high efficiency filters and filter installations. Author (NSA)

N66-33919# California Univ., Livermore. Lawrence Radiation Lab.

GUN FACILITY FOR DYNAMIC IMPACT STUDIES OF EXPLOSIVE MATERIALS

R. J. Wasley and J. F. O'Brien 16 Nov. 1965 9 p refs

(Contract W-7405-ENG-48)

(UCRL-14543) CFSTI: HC $1.00/MF $0.50

A gun facility is described that is designed and constructed to conduct both scientific and routine dynamic investigations (usually) with explosives. The system is inexpensive, dependable, and versatile and exhibits several unique features: the gun is not fixed and is allowed to recoil in a manner such that no rotation of the barrel occurs; projectiles may be either breech-loaded for precision experiments in vacuum or muzzle-loaded for certain experiments involving larger quantities of explosive and in which impact occurs some distance (several feet) downrange; the sample holder assembly, if used, is isolated from the gun itself by means of a thin flexible rubber diaphragm to reduce the coupling of elastic vibrations, and the specimen is separated from the muzzle tip to provide protection to the barrel. Author (NSA)

N66-34068# Ballistic Research Labs., Aberdeen Proving Ground, Md.

ELECTRIC AIR HEATER FOR SUPERSONIC WIND TUNNELS

Ernest P. Reklis Sep. 1965 89 p refs

(BRL-TN-1599; AD-634504) CFSTI: HC $3.00/MF $0.75

In the hypersonic wind tunnel air cycle, the electric air heater is used as a vernier temperature control for heater air prior to the time that it enters the settling section. This report describes the air heater and may also serve as an operating manual. Appendices contain specifications, maintenance instructions and design information. Author (TAB)

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N66-32721*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A THEORETICAL AND EXPERIMENTAL INVESTIGATION OF SECONDARY JETS IN A MACH 6 FREE STREAM WITH EMPHASIS ON THE STRUCTURE OF THE JET AND SEPARATION AHEAD OF THE JET

James R. Sterrett and John B. Barber [1966] 31 p refs Presented at the AGARD Separated Flows Specialists Meeting, Brussels, 9–11 May 1966

(NASA-TM-X-57137) CFSTI: HC $2.00/MF $0.50 CSCL 20D

An experimental and theoretical investigation to determine the actual fluid processes in the interaction of secondary gaseous jets with a primary flow has been conducted. The experimental phase of the program consisted of an investigation of free jets exhausting against a flat plate, including interferograms taken with a laser grating interferometer, and an investigation conducted in a Mach 6 wind tunnel with secondary jets of various exit Mach numbers issuing perpendicularly from a flat plate. The theoretical investigation included the calculation of various free jet patterns by the use of the two-dimensional characteristic theory for various boundary conditions and the examination of various shock calculations for different shock patterns. Since this is a problem area where separation plays a prominent role, an analogy between different types of separated flow is presented. From these studies, realistic flow models have been constructed and various design parameters have been determined experimentally. Author

N66-32724*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

A STUDY OF SECONDARY INJECTION OF GASES INTO A SUPERSONIC FLOW

F. W. Spaid, E. E. Zukoski, and R. Rosen 1 Aug. 1966 86 p refs
(Contract NAS7-100)
(NASA-CR-76891; JPL-TR-32-834) CFSTI: HC $2.00/MF $0.75 CSCL 20D

The flow field around the injection port for secondary injection of a gas normal to a supersonic stream has been studied in a series of wind-tunnel experiments. The experiments were conducted at free-stream Mach numbers of 1.38 to 4.54. Gaseous nitrogen, argon, and helium were injected through a circular hole and sonic flow was maintained at the injection orifice. Data presented include static-pressure distributions on the wall in the region of the injector, shock shapes, and injectant-mass-fraction, total-pressure, and velocity profiles downstream of the injector. A scale parameter has been calculated, based on a simple, inviscid model of the flow field. This scale parameter gives a good general correlation of the data. Use of this scale parameter allows the prediction of a simple scaling law for the normal forces on a wall produced by secondary injection, which is in approximate agreement with existing rocket-motor test results. Author

N66-32857# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.
PHOTOGRAPHY OF HEATED SURFACE FLUID BEHAVIOR FOR TRANSITION BOILING AT 1000 PSIA
C. L. Swan Jan. 1966 34 p refs
(Contract AT(04-3)-189)
(GEAP-5094; EURAEC-1606) CFSTI: HC $2.00/MF $0.50

Selected motion picture frames are presented to illustrate the forced flow fluid behavior on a single-rod heated surface during the critical heat flux, transition boiling, and film boiling conditions at 1000 psia. A sequence in which the heated surface is visible by self-incandescence, in the transition boiling region, is also presented. The heated surface fluid behavior, although not visible, may be inferred from the development of incandescent patches during the cyclic heating and cooling. Both a smooth and finned heated surface were tested. Although improved heat transfer conditions prevailed for the finned surface, no visible differences of the surface fluid behavior were noted. Evidence was obtained to support the view that the critical heat flux occurs by separation and subsequent break-up of a liquid film from the heated surface. Author (NSA)

N66-32906 Advisory Group for Aerospace Research and Development, Paris (France).
SEPARATED FLOWS, PART I
May 1966 503 p refs Proc. of the AGARD Specialists Meeting on Separated Flows, Rhode-Saint-Genese, Belgium, 10-13 May 1966; sponsored by the AGARD Fluid Dyn. Panel
(AGARD-CP-4, Pt. I) CFSTI: HC $5.53/MF $2.50

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15. HEAT AND MASS EXCHANGE IN THE SUPERSONIC BASE REGION C. J. Scott and E. R. G. Eckert (Minn. Univ.) p 429-478 refs (See N66-32921 19-33)

N66-32907 Centre National de la Recherche Scientifique, Meudon (France). Laboratoire d'Aerothermique du CNRS.
THE BASE BLOW PROBLEM AT VERY LOW REYNOLDS NUMBERS [L'ECOULEMENT DE CULOT AUX FAIBLES NOMBRES DE REYNOLDS]
H. Viviand and S. A. Berger (Calif. Univ., Berkeley) *In* AGARD Separated Flows, Pt. I May 1966 p 1-29 refs In FRENCH; ENGLISH summary (See N66-32906 19-12) CFSTI: HC $5.53/MF $2.50

The base flow problem at very low Reynolds numbers is studied by means of the Stokes approximation. Stokes equations are solved, for two-dimensional and axisymmetric flows, in the half-space downstream of the base plane, for an arbitrarily given velocity field in this plane. Examples of two-dimensional base flows, calculated by means of this solution, are presented, and the influence of various parameters, used to define the flow conditions in the base plane, is studied. Author

N66-32908# Itek Corp., Palo Alto, Calif. Vidya Div.
THEORY OF LAMINAR SEPARATED FLOWS ON FLARED SURFACES INCLUDING SUPERSONIC FLOW WITH HEATING AND COOLING
L. L. Lynes (MB Associates, San Ramon, Calif.), J. N. Nielsen, and F. K. Goodwin *In* AGARD Separated Flows, Pt. I May 1966 p 31–68 refs (See N66-32906 19-12) CFSTI: HC $5.53/MF $2.50

A method is developed based on the Dorodnitsyn method of integral relations to obtain solutions to the laminar boundary-layer equations for separated flows induced on a plate by a ramp or induced on a cylinder by a conical flare. The analysis applies at any speed for a boundary layer under the influence of a specified pressure gradient for hot or cold walls. The analysis also applies to supersonic flow wherein the pressure distribution is not specified but is determined by free interaction between the boundary layer and the outer flow. The actual method of solution is by digital computer. A number of systematic calculations have been made to study the effects of Mach number, Reynolds number, and heating and cooling on laminar separation and reattachment. A number of comparisons made between theory and experiment for two-dimensional and axisymmetric flow as well as adiabatic and nonadiabatic flows show generally good agreement. A number of flow phenomena revealed by the calculations are presented. Author

N66-32909# California Univ., Berkeley.
SEPARATION OF LAMINAR BOUNDARY-LAYER FLOW PAST A CONCAVE CORNER
Maurice Holt *In* AGARD Separated Flows, Pt. I May 1966 p 69–87 refs (See N66-32906 19-12) CFSTI: HC $5.53/MF $2.50
(Grant AF-AFOSR-268-65)

Separation of a supersonic laminar boundary layer near a concave corner, due to a free interaction process, is investigated by the method of integral relations. The shearing stress is represented as a two parameter function of the streamwise velocity component. Different representations are used in the attached and separated regions but, in both regions, they are applied all the way to the wall. As a result, the basic integral relation can always be integrated from the wall to the outer edge of the boundary layer and there is no need to split the separated layer into two parts. The solution of the attached flow equations runs smoothly into that of the separated layer equations. In a typical case the solution gives a continuously decreasing wall shearing stress and a pressure distribution outside the boundary layer increasing up to and beyond the separation point. Author

N66-32910# Imperial Coll. of Science and Technology, London (England). Dept. of Aeronautics.
HYPERSONIC STUDIES OF INCIPIENT SEPARATION AND SEPARATED FLOWS
D. A. Needham and J. L. Stollery *In* AGARD Separated Flows, Pt. I May 1966 p 89–119 refs (See N66-32906 19-12) CFSTI: HC $5.53/MF $2.50

This paper describes an experimental study of hypersonic flow separation performed in a gun tunnel. Separation of both laminar and transitional boundary layers resulting from interaction with either an incident oblique shock or a wedge compression-corner are investigated over the Mach number range 7.4 to 14.5 by means of schlieren photography and surface measurements of pressure and heat-transfer rate. The concept of incipient separation is shown to be valid and an alternative method of detecting this condition is suggested based on heat-transfer-rate measurements. The incipient separation angle and the extent to which the flow separates are critically dependent on the state of the boundary layer. The way in which these quantities vary with unit Reynolds number in a fully laminar or turbulent flow is entirely different to their behaviour when the flow is transitional. Since much of the flow under "cold wall" conditions appears to be dominated by the mass-carrying, energetic, outer part of the boundary layer some changes in hinge-line geometry were made in order to test the relative importance of the inner flow. Finally a few tests were made with a heated model to find the effect of wall temperature. Author

N66-32911# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
BOUNDARY-LAYER SEPARATION AND REATTACHMENT WITH AND WITHOUT ABLATION
D. M. Kuehn and D. J. Monson *In* AGARD Separated Flows, Pt. I May 1966 p 121–145 refs (See N66-32906 19-12) CFSTI: HC $5.53/MF $2.50

Laminar boundary-layer separation on ablating and nonablating axisymmetric bodies has been investigated at low Reynolds numbers and at a hypersonic Mach number. Two classes of models were studied: (1) cylinder-flare models and (2) blunt-faced base-flow models. Various flare and base angles were tested in order to span conditions for attached flow to separated flow. Three ablation materials were used. The flows were studied with the aid of pressure distributions, surface oil accumulations and streaks, burn patterns, and photographs of the glow about the models. The results show that large turning angles are possible for thick, laminar boundary layers at low Reynolds numbers. Ablation had, at most, only a small influence on the extent of laminar separation, but in some cases had considerable influence on surface pressures. Evidence is presented of ablation-induced transition of the boundary layer near separation on one of the models. Author

N66-32912# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
THEORETICAL AND EXPERIMENTAL STUDIES OF SEPARATED FLOWS INDUCED BY SHOCK-WAVE-BOUNDARY-LAYER INTERACTION
M. S. Holden *In* AGARD Separated Flows, Pt. I May 1966 p 147–180 refs (See N66-32906 19-12) CFSTI: HC $5.53/MF $2.50
(Contracts NAS5-3976; Nonr-2653(00); AF 33(615)-1205)

This paper describes a theoretical and experimental study of the shock-wave-laminar boundary-layer interaction problem. The theoretical analysis describes the attached and separated interaction regions induced by the impingement of an oblique shock on the boundary layer, and by a forward-facing wedge on a flat plate. This theory compares favorably with pressure and heat transfer measurements in these interaction regions, both in adiabatic and highly cooled flows. The analysis also successfully describes the size and properties of an interaction region as the strength of the interaction is varied, and also predicts the interaction strength causing incipient separation. The experimental investigation was an exploratory study in a shock tunnel of the shock-wave–boundary-layer interaction developed over a flat plate-wedge model. The emphasis here was on (1) the time to establish a steady separated flow, (2) the effect of finite model span on the attached and separated flows, and (3) the determination and correlation of incipient separation conditions. Author

N66-32913# General Dynamics/Convair, San Diego, Calif. Space Science Lab.
NUMERICAL CALCULATION OF SEPARATED FLOW FIELDS

Hans U. Thommen and Richard J. Magnus *In* AGARD Separated Flows, Pt. I May 1966 p 181–205 refs (See N66-32906 19-12) CFSTI: HC $5.53/MF $2.50

In this paper a numerical method for the integration of the Navier–Stokes equations for unsteady, compressible flow is discussed. The difference scheme proposed is a two-step Lax–Wendroff scheme, modified to take into account the influences of viscosity and heat conduction. The accuracy and stability of the difference scheme are studied theoretically and numerically, using either the full Navier–Stokes equations or the simpler Burgers equation. The application to separated flow fields is discussed and some observations on early pilot calculations are presented. Author

N66-32914# California Univ., Los Angeles. Dept. of Engineering.

STUDIES ON LAMINAR AND TURBULENT FREE SHEAR LAYERS WITH A FINITE INITIAL BOUNDARY LAYER AT SEPARATION

A. F. Charwat and J. Der, Jr. *In* AGARD Separated Flows, Pt. I May 1966 p 207–240 refs (See N66-32906 19-12) CFSTI: HC $5.53/MF $2.50

(Grant NSF GP-2350)

Initial results of a coupled experimental and analytical (numerical) study of the development of a free shear layer originating from an attached boundary layer of finite thickness are described. An unusual transformation of the boundary-layer equations which is particularly well suited for numerical integration of free shear layer problems is presented. Calculations for both symmetrical (incompressible) wakes behind an infinitely thin plate and for unsymmetrical (compressible) free shear layers in laminar flow for families of initial profiles are shown; the sensitivity to pressure gradients imposed on the shear layer is demonstrated. Partial experimental data showing the development of turbulent shear layers immediately downstream of separation are included. Author

N66-32915# France. Office National d'Etudes et de Recherches Aeronautiques, Chatillon-Sous-Bagneux.

CONTRIBUTION TO THE EXPERIMENTAL STUDY OF THE ISOBARIC TURBULENT MIXTURE LAYER OF SUPERSONIC FLOW [CONTRIBUTION A L'ETUDE EXPERIMENTALE DE LA COUCHE DE MELANGE TURBULENT ISOBARE D'UN ECOULEMENT SUPERSONIQUE]

M. Sirieix and J. L. Solignac *In* AGARD Separated Flows, Pt. I May 1966 p 241–270 refs In FRENCH; ENGLISH summary (See N66-32906 19-12) CFSTI: HC $5.53/MF $2.50

A review is made of the theoretical results available, and an experimental study, carried out at Mach 3 and 4, is presented. The evolution of the velocity, temperature and concentration curves is analyzed, particularly in the area of the isobaric turbulent mixture dependent on the pre-existing boundary layer. Author

N66-32916# Ecole Royale Militaire, Brussels (Belgium).

SUPERSONIC TURBULENT MIXING AND ITS APPLICATION TO PROBLEMS OF REATTACHMENT [MELANGE SUPERSONIQUE TURBULENT ET APPLICATION AUX PROBLEMES DE RECOLLEMENT]

R. Jacques and A. Gailly *In* AGARD Separated Flows, Pt. I May 1966 p 271–301 refs In FRENCH; ENGLISH summary (See N66-32906 19-12) CFSTI: HC $5.53/MF $2.50

A new method of determining velocities, mass flows, temperatures and viscous stresses within a turbulent, compressible isobar mixing layer is established. It is applicable in the region where the velocity profiled may be considered as similar and when the flow is steady, isoenergetic and two-dimensional. The method may be extended to the case of an axisymetric flow and remains valid for laminar flow. The results obtained through this method are used for the calculation of the base pressure or the reattachment angle, with or without injection, by applying the Korst–Chapman criterion. In view of the disagreement between theoretical and experimental results, a new correlation method based on the experimental results of Carriere is proposed; it is valid for bi-dimensional reattachment as well as conical reattachment. Author

N66-32917# Avco Corp., Wilmington, Mass. Aerophysics Dept.

TURBULENT MIXING IN SUPERSONIC FLOW PAST SLENDER BODIES WITH LARGE BLOWING

Barry L. Reeves *In* AGARD Separated Flows, Pt. I May 1966 p 303–324 refs Sponsored by AF (See N66-32906 19-12) CFSTI: HC $5.53/MF $2.50

In this paper supersonic flow past slender bodies with large blowing from the surface is investigated. If the flow in the blowing region is turbulent, in some circumstances the mean flow can be self-preserving, and the equations of mean motion for constant-density flow behind the bow shock wave are satisfied by conical forms of the turbulent and mean velocities. By introducing a scalar coefficient of eddy viscosity, solutions of the similarity equations are obtained in terms of a turbulent Reynolds number. It is shown that, for normal injection, and for sufficiently large values of the Reynolds number, the blowing region consists of three sub-regions: a virtually inviscid region near the surface, a shear layer along the dividing streamline, and an intermediate "turning layer" in which $V/U \sim o(1)$. Quantitative results for the effect of large blowing on the flow fields about a flat plate and a slender cone are obtained. Author

N66-32918# Washington Univ., Seattle.

THE PREDICTION OF SEPARATION AND REATTACHMENT FLOW CHARACTERISTICS FOR TWO-DIMENSIONAL SUPERSONIC AND HYPERSONIC TURBULENT BOUNDARY LAYERS

Morris E. Childs, Gerald C. Paynter, and Eleanor Redeker (Boeing Co., Seattle, Wash.) *In* AGARD Separated Flows, Pt. I May 1966 p 325–352 refs (See N66-32906 19-12) CFSTI: HC $5.53/MF $2.50

An analytical technique was developed for predicting the location of separation and reattachment and the magnitude of the reattachment pressures and gradients in turbulent boundary-layer separation. The method is applicable to free-interaction separations caused by deflected control surfaces or shock impingement, and has been found to give results which agree well with Mach 3 to Mach 8 experimental data from a number of different sources. The method of solution is based on a control volume analysis of the separation bubble. Only initial boundary-layer properties and shock strength or ramp angle must be known. The concept of an equivalent constant pressure free shear layer which allows for the effect of an initial boundary layer is used in treating the mixing process adjacent to the separation bubble. The actual shear layer, which develops as a continuation of the previously attached boundary layer, is replaced by an equivalent mixing layer. This hypothetical mixing layer is assumed to be the result of the mixing between a uniform stream and an ambient fluid at rest. The origin of the equivalent layer and the relationship between the equivalent and actual flows is established by equating, at separation, the momentum and mass

fluxes below an external reference stream surface in the equivalent layer to the momentum and mass fluxes below the corresponding stream surface in the actual flow. Author

N66-32919# France. Office National d'Etudes et de Recherches Aeronautiques, Chatillon-sous-Bagneux.
BASIC EXPERIMENTS ON TURBULENT REATTACHMENT OF A SUPERSONIC JET [EXPERIENCES FONDAMENTALES SUR LE RECOLLEMENT TURBULENT D'UN JET SUPERSONIQUE]
M. Sirieix, J. Mirande, and J. Delery *In* AGARD Separated Flow, Pt. I May 1966 p 353–390 refs In FRENCH; ENGLISH summary (See N66-32906 19-12) CFSTI: HC $5.53/MF $2.50

A survey is made of the basic data yielded by previous experiments on turbulent reattachment, and a detailed analysis of the recompression field, from data provided by refined methods is presented. Various characteristics are brought out: mainly, the existence of critical points and of a law of similarity in the evolution of wall pressures. An attempt has been made to acquire a more precise knowledge of the reattachment structure; interferometry methods have made it possible to obtain the evolution of the boundary layer thicknesses during reattachment. Author

N66-32920# Royal Aircraft Establishment, Bedford (England).
TWO-DIMENSIONAL TURBULENT REATTACHMENT AS A BOUNDARY-LAYER PROBLEM
J. E. Green *In* AGARD Separated Flows, Pt. I May 1966 p 393–427 refs (See N66-32906 19-12) CFSTI: HC $5.53/MF $2.50

A conventional boundary-layer analysis is extended to treat the development of a steady turbulent wake downstream of a base. By a process of iterative calculation, a solution is obtained in which the outer potential flow and the wake flow are compatible and mutually dependent. The wake calculation takes into account the reversed flow in the "dead-air" region, and the solution includes a description of the reattachment process. Attention is confined to steady, two-dimensional, incompressible base-flows. A typical solution for this type of flow is described in detail, and is shown to be in good qualitative agreement with measurements of reattachment behind rearward-facing steps. Extension of the treatment to other types of steady separated flow is thought possible. As a result of the analysis, a way of qualitatively discussing reattachment is suggested and a recent correlation of experimental data is supported. Author

N66-32926 Advisory Group for Aerospace Research and Development, Paris (France).
SEPARATED FLOWS, PART 2
May 1966 445 p refs Proc. of Specialists Meeting, Rhode-Sainte-Genese, Belgium, 10–13 May 1966 Sponsored by the AGARD Fluid Dyn. Panel
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N66-32927# National Physical Lab., Teddington (England).
INVESTIGATION INTO THE EFFECT OF BASE BLEED ON THE FLOW BEHIND A TWO-DIMENSIONAL MODEL WITH A BLUNT TRAILING EDGE
P. W. Bearman *In* AGARD Separated Flows, Pt. 2 May 1966 p 479–507 refs (See N66-32928 19-12) CFSTI: HC $4.95/MF $2.25

The effects of base bleed on the flow about a two-dimensional model with a blunt trailing edge were examined at Reynolds numbers, based on model base height, between 1.3×10^4 and 4.1×10^4. The ratio of total boundary-layer thickness at the trailing edge to model base height was approximately 0.4. Measurements were made of base pressure, vortex shedding frequency, and the distance to vortex formation. With a sufficiently large bleed quantity the regular vortex street pattern disappeared and the base drag of the section could be reduced to about a third of its original value. The base pressure was found to vary linearly with the inverse of the vortex formation distance. Results of a previous splitter plate investigation were found to agree closely with those of the present experiments. Author

N66-32928# Southampton Univ. (England). Dept. of Aeronautics and Astronautics.

A STUDY OF THE OSCILLATING LAMINAR SEPARATED FLOW AHEAD OF A FORWARD FACING STEP OSCILLATING TRANSVERSELY TO A HYPERSONIC FREE STREAM

R. A. East and P. R. Wilkinson *In* AGARD Separated Flows, Pt. 2 May 1966 p 509–537 refs (See N66-32926 19-12) CFSTI: HC $4.95/MF $2.25

This paper presents a theoretical and experimental study of the oscillating laminar separated flow formed ahead of a forward facing step which is oscillating transversely to a hypersonic free steam. The experimental results demonstrate that the separated flow region does not behave in a quasi-steady-manner and that appreciable phase differences exist between the movement of the separation point and that of the step. The experiments were performed in a hypersonic gun tunnel at Mach numbers in the range $8.4<M<12.5$ and unit Reynolds numbers of 10^4 to 10^7 per foot. The theoretical work suggests certain parameters upon which the characteristics of this phenomenon depend. These are examined in the light of the experimental results. Author

N66-32929# Technische Hochschule Aachen (West Germany). Aerodynamisches Institut.

THE CONDITIONS OF SEPARATION AND VORTEX FORMATION PAST CYLINDERS

A. Naumann, M. Morsbach, and C. Kramer *In* AGARD Separated Flows, Pt. 2 May 1966 p 539–574 refs (See N66-32926 19-12) CFSTI: HC $4.95/MF $2.25

This report gives a summary of the results of experiments on flow pattern and flow-separation conditions past circular cylinders and through cylinder gratings. The interaction between local shock waves and the boundary-layer separation in flow regimes at critical Mach number is considered. At high (supercritical) Reynolds numbers, shock waves produce a well-defined separation line parallel to the cylinder axis and a vortex street occurs. Experiments on conditions of separation at supercritical Reynolds numbers in incompressible flow are described. Regular vortex formation involves, as a necessary condition, a linear separation line parallel to the cylinder axis and it also depends on differences of circulation in the separating discontinuity surface. The flow behavior past gratings consisting of a single row of circular cylinders is also described. The characteristic results are the interaction between parallel vortex streets and the calculation of the stable arrangements. The speeds at which the experiments were conducted ranged from low values of Mach numbers to high subsonic Mach numbers at which choking occurred. Author

N66-32930# Deutsche Versuchsanstalt für luft- und Raumfahrt, Berlin (West Germany). Institut für Turbulenzforschung.

THE INSTABILITY AND THE FORMATION OF VORTICES IN A FREE BOUNDARY LAYER

A. Michalke and P. Freymuth *In* AGARD Separated Flows, Pt. 2 May 1966 p 575–595 refs (See N66-32926 19-12) CFSTI: HC $4.95/MF $2.25

The instability and the formation of vortices in free boundary layers are investigated for large Reynolds numbers, experimentally by means of the hot-wire technique, and theoretically by means of the inviscid linearized stability theory of spatially growing disturbances. It is found that, by the influence of sound, sinusoidal disturbances with a certain initial disturbance of magnitude proportional to the sound pressure are excited which grow exponentially with downstream distance. The growth rate is nearly independent of the Reynolds number, but depends on the Strouhal number. Also the formation of vortices does not seem to be noticeably affected by viscosity. From the theoretical results it can be concluded that the linearized stability theory of spatially growing disturbances gives a good description of the instability properties observed in the experiments. Furthermore, from the calculated streakline pattern it follows that the linearized theory includes approximately the rolling-up process of the free boundary layer. Author

N66-32931# Deutsche Versuchsanstalt für luft- und Raumfahrt, Porz (West Germany). Institut für Angewandte Gasdynamik.

THREE-DIMENSIONAL EFFECTS IN SHOCK-SEPARATED FLOW REGIONS AHEAD OF LATERAL CONTROL-JETS ISSUING FROM SLOT NOZZLES OF FINITE LENGTH

F. Maurer *In* AGARD Separated Flows, Pt. 2 May 1966 p 597–634 refs (See N66-32926 19-12) CFSTI: HC $4.95/MF $2.25

The separated flow field ahead of side-jets expanding from slot nozzles of finite length into supersonic free jet wind-tunnel flows is investigated by means of pressure distribution measurements, surface oil-flow pictures and schlieren pictures. The oil-flow pictures show the lines of flow separation as well as streamlines of the two flows. The streamlines inside the separated regions show a remarkable influence from the lateral edges of the jets. The existence of a crossflow, superimposed on the two-dimensional flow inside the separated region ahead of the jet, is verified. Some interesting three-dimensional perturbations in the process of jet attachment downstream of the jet exit are described. The experimental evidence provides a basis for an analytical approach to the problem. The results of iterative flow-field calculations agree rather well with the experiments. The discussion of assumptions introduced in the analysis contributes to a better understanding of the mechanism of three-dimensional flow interaction. Author

N66-32932# General Applied Science Labs., Inc., Westbury, N. Y.

SHOCK WAVE-LAMINAR BOUNDARY-LAYER INTERACTION: INTEGRAL ANALYSIS AND EXPERIMENTAL RESULTS

A. Martellucci and F. W. Lipfert *In* AGARD Separated Flows, Pt. 2 May 1966 p 635–665 refs (See N66-32926 19-12) CFSTI: HC $4.95/MF $2.25

The shock wave-boundary-layer interaction problem is considered from two aspects: an integral method for analyzing laminar flows, and an experimental study of impinging shocks at Mach No. 5.4 under laminar and transitional conditions. The analysis considers the general case of a planar shock wave, which is swept with respect to the flow external to the boundary layer, and shows that it can be reduced to a two-dimensional problem. The technique of solution for the boundary-layer properties is based on the Karman–Pohlhausen integral method for the momentum, and energy equations, with the pressure distribution unknown and the velocity external to the boundary layer as the independent variable. The analysis is compared to experimental data for impinging shocks from Mach No. 2.0 to 5.4; excellent agreement is shown for the purely laminar cases. Author

N66-32933# Cordoba National Univ. (Argentina). Aerodynamics Lab.

A STUDY OF AXIALLY SYMMETRICAL BASE FLOW BEHIND BODIES OF REVOLUTION AT SUPERSONIC SPEEDS

Joseph S. A. de Krasinki *In* AGARD Separated Flows, Pt. 2 May 1966 p 747–778 refs (See N66-32926 19-12) CFSTI: HC $4.95/MF $2.25

Detailed tests were made in the wake of axially cylindrical adiabatic models at M=1.48 and M=2.55 covering the laminar, transitional and turbulent Reynolds number range. The tests included inverted flow measurements, and indicated that the separated flow field behind the base face forms a system where the mixing processes in the throat, the final energy level of the dividing streamline, and the intensity of the returned mass flow are connected together organically. This point of view reconciles the contradictory tenets of the dividing streamline and Crocco–Lees theories without accepting details. The dividing streamline as computed from measurements can reach, close to the base, an energy level above the maximum theoretical one, and its total pressure adjusts itself to the level prescribed by the mixing processes in the throat. More evidence has been collected which confirms Bogdonoff's findings that the base pressure minimum can be reached when the mixing layer is laminar up to reattachment, and transition occurs abruptly in the throat. Profiles of the separated laminar boundary layer up to the beginning of recompression have a considerably lower momentum thickness than the fully developed laminar or turbulent ones. Author

N66-32934# London Univ. (England). Dept. of Aeronautical Engineering.

SOME RESULTS OF INVESTIGATIONS OF SEPARATION BUBBLES

A. D. Young and H. P. Horton *In* AGARD Separated Flows, Pt. 2 May 1966 p 779–811 refs (See N66-32926 19-12) CFSTI: HC $4.95/MF $2.25

Part I deals with two-dimensional bubbles, in the first place as measured on airfoils and later on a flat plate with a suitable pressure distribution induced by a nearby auxiliary wing and also by a porous cylinder with circulation control provided by suction and a Thwaites flap. Gaster's criterion for the bursting of short bubbles is discussed and extended in the light of recent results and an argument is presented linking it with earlier criteria. Part II deals with three-dimensional bubbles on a swept plate similarly induced by a swept porous cylinder with a Thwaites flap. The results of streamwise and cross-flow velocity measurements, as well as pressure measurements, are presented and compared with the two-dimensional results. Author

N66-32935# National Physical Lab., Teddington (England).

THE STRUCTURE AND BEHAVIOUR OF LAMINAR SEPARATION BUBBLES

M. Gaster *In* AGARD Separated Flows, Pt. 2 May 1966 p 813–854 refs (See N66-32926 19-12) CFSTI: HC $4.95/MF $2.25

A study of laminar separation bubbles formed under a wide range of Reynolds numbers and pressure distributions has been made. The structure of the bubble depended on the value of the Reynolds number of the separating boundary layer and a parameter based on the pressure rise over the region occupied by the bubble. Conditions for the bursting of "short" bubbles were determined by a unique relationship between these two parameters. Hot-wire measurements of both mean and fluctuating velocity in the separated region, together with oscilloscope records of the fluctuations explain some of the flow mechanisms involved. Author

N66-32936# Deutsche Forschungsanstalt für Luft- und Raumfahrt, Bochum (West Germany).

THE SEPARATION OF THE TURBULENT BOUNDARY LAYER AS INFLUENCED BY BLOWING, SUCTION, MOVING WALL, AND PROPELLER SLIPSTREAM

K. Gersten *In* AGARD Separated Flows, Pt. 2 May 1966 p 855–886 refs (See N66-32926 19-12) CFSTI: HC $4.95/MF $2.25

To obtain detailed information about the influence of different means of boundary-layer control on separation of the turbulent boundary layer, experimental investigations have been carried out: The effect of blowing tangentially into a boundary layer from a narrow slot on the location of separation, which occurs due to a strong adverse pressure gradient, has been investigated, the blowing velocity being the main parameter. In order to simulate the flow characteristics in the neighborhood of a suction slot of an airfoil having suction equipment for high lift, the flow along the wall was forced to separate by a rectangular backward-facing step. The effects of suction quantity on reattachment point, as well as on the boundary-layer characteristics downstream of the separation region, are shown. The effect of spinning velocity on the boundary-layer along a body of revolution in axial flow was investigated in detail, and the boundary-layer characteristics and the separation line on the rear part of a body of revolution have been measured under the influence of the slipstream of a propeller mounted just behind the body. From these measurements it can be shown how the location of separation is affected by the thrust coefficient and the distance of the propeller. Author

N66-32937# Aerodynamische Versuchsanstalt, Göttingen (West Germany).

THE WAKE PRESSURE BEHIND WEDGES AS INFLUENCED BY SPLITTER PLATES AND SUCTION

M. Tanner *In* AGARD Separated Flows, Pt. 2 May 1966 p 887–909 refs (See N66-32926 19-12) CFSTI: HC $4.95/MF $2.25

Investigations were made of the base pressure on isosceles wedges in two-dimensional incompressible flow. Measurements were carried out on the influence of splitter plates of different length and the influence of suction of air through a long porous splitter plate. A pronounced effect of both the length of the splitter plate and the suction on the flow pattern has been found. Based on the experiences gained in the experiments previously mentioned, a theory of the flow in wakes has been established. The analysis shows that the amount of the incoming flow and of the outgoing flow of the closed wake bubble are the significant parameters. It is indicated also that the actually existing base pressure depends on the amount of outflow from the wake bubble. It has been possible to derive an equation relating the base pressure and drag coefficient to the amount of outflow of the wake. A comparison of the theoretical outflow with experiments shows good agreement in the whole region of wedge angles from 0° to 180°. Author

N66-32939# National Lucht- en Ruimtevaartlaboratorium, Amsterdam (Netherlands).

WIND TUNNEL EXPERIMENTS ON UNSTEADY CAVITY FLOW AT HIGH SUBSONIC SPEEDS

B. M. Spee *In* AGARD Separated Flows, Pt. 2 May 1966 p 941–974 refs (See N66-32926 19-12) CFSTI: HC $4.95/MF $2.25

Wind tunnel experiments have been done on the unsteady flow over a cavity system at high subsonic speeds. The investigation is part of an experimental program on the interaction

between sound waves and two-dimensional transonic flows. The purpose of the present experiments is to examine whether the sound field radiated by the cavity system would be suitable for such interaction studies. The tests were performed on a two-dimensional cavity system consisting of a rectangular gap connected with a resonance chamber. The Mach number range was from 0.4 to 0.85. The investigation involved schlieren and shadowgraph observations, as well as measurements of the frequency and intensity of the radiated field. Periodically fluctuating flows can be characterized by their feedback mechanism. In the present tests the pressure related to the resonance chamber oscillations is the feedback force. This results in a relatively simple and clean cavity flow. The cavity behaves, at some distance, like an acoustic monopole and emits intense acoustic radiation. The radiated sound field in general meets requirements concerning two-dimensionality and variability of frequency and intensity. Author

N66-32940*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A REVIEW OF FACTORS AFFECTING BOUNDARY-LAYER TRANSITION

Albert L. Braslow Washington, NASA, Aug. 1966 30 p refs
(NASA-TN-D-3384) CFSTI: HC $2.00/MF $0.50 CSCL 20D

A brief review is made of the current state of the art of boundary-layer transition. Discussion, in various degrees of detail, are experimentally determined effects on transition of pressure gradients, surface to free-stream temperature ratio, free-stream Mach number, free-stream turbulence, noise, two- and three-dimensional-type surface roughness, and laminar boundary-layer control through suction. Certain aspects of the theoretical approach to transition are discussed and some comparisons with experiment are made. The review is intended primarily for the engineer or scientist desiring a general understanding of boundary-layer transition phenomena rather than for the active researcher in the field of fluid mechanics. Some needs for further research are indicated. Author

N66-33022*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ATTENUATION OF SINUSOIDAL DISTURBANCES IN NONVISCOUS LIQUID FLOWING IN A LONG LINE WITH DISTRIBUTED LEAKAGE

Robert J. Blade and Carl M. Holland Washington, NASA, Aug. 1966 29 p refs
(NASA-TN-D-3563) CFSTI: HC $2.00/MF $0.50 CSCL 20D

Sinusoidal disturbances from 0.5 to 82 cps superimposed on the flow of nonviscous liquid were attenuated to design values in a 66-foot-long (20.1 m) line. The disturbances were attenuated by placing shunt assemblies that simulate distributed leakage along the line. Experimental values of the attenuation constant were determined and compared with the design values that were obtained from analogous electrical transmission line theory. The results showed that sinusoidal perturbations at a given frequency can be attenuated to a design value by using shunt assemblies and that theory and experiment agreed well. Author

N66-33112# Centre National de la Recherche Scientifique, Meudon (France). Laboratoire d'Aerothermique.

CONCENTRATION PROFILES FOR A LAMINAR BOUNDARY LAYER WITH CATALYTIC REACTION AT THE WALL [PROFILS DES CONCENTRATIONS DANS UNE COUCHE LIMITE LAMINAIRE FIGEE AVEC REACTION CATALYTIQUE A LA PAROI]

Gérard Lassau and Bernard Le Fur May 1966 44 p refs In FRENCH *Its* Publ. No. 227
(Rept.-66-3) CFSTI: HC $2.00/MF $0.50

An iterative method is presented for the integration of profiles of the laminar boundary layer in a fluid with constant physical properties, and a study is made of the binary reaction in the layer with catalysis along the wall. Concentration profiles are determined so that the physical properties are independent of either the concentration or pressure. The equations are integrated as first order approximations by neglecting certain terms. Second order approximations can be determined for the mass flux and the constraints along the wall; and these permit the modification of the first order profiles in such a way as to give the secondary approximation. These results agree within 1% with those obtained by other means for simple cases. Transl. by M.W.R.

N66-33130# United Kingdom Atomic Energy Authority, Culham (England). Research Group.

CONDITIONS AT EQUILIBRIUM BEHIND STRONG SHOCK WAVES IN HYDROGEN

D. L. Fisher Jan. 1966 20 p refs
(CLM-R56) HMSO: 2s 6d

The equilibrium conditions behind strong shock waves travelling into hydrogen gas at ambient laboratory temperature and at a range of initial pressures, values of magnetic field, and fractions of ionization have been determined by solving the Rankine–Hugoniot equations coupled with the Saha equation. Author

N66-33251# Brown Univ., Providence, R. I. Div. of Engineering.

STRONGLY RADIATING HYPERSONIC FLOW OVER A SPHERE: AN ASYMPTOTIC SKETCH

Ira M. Cohen May 1966 30 p refs
(Contract Nonr-562(35))
(Nonr-562(35); AD-633956) CFSTI: HC $2.00/MF $0.50

The problem of an inviscid hypersonic flow of a radiating gray gas over a sphere is formulated in the limit of large $\Gamma \equiv \sigma U^5/(\rho_\infty c_p^4)$ where σ is the Stefan–Boltzmann constant, U is free stream speed, ρ_∞ is free stream density, and c_p is specific heat. The limit $\Gamma \to \infty$ (with Mach number sufficiently large that a shock occurs) splits the flow field into four distinct regions: a precursor region upstream of the shock scaled by $r-\Gamma$, the shock wave itself scaled by the mean free path, a thin emission layer just downstream of the shock scaled by $r-r_s \sim 1/\Gamma$, and the shock layer scaled by $r \sim 1$. The most significant results to emerge from the analysis are: (1) The thermal precursor extends to distances of the order of Γr_b upstream of the shock. (2) The temperature immediately upstream of the inviscid discontinuity (shock) is a constant, i.e., does not vary with the angle θ measured from the stagnation streamline. (3) The temperature immediately downstream of the thin emission layer is the same as the temperature just upstream of the shock. (4) The radial component of radiative heat-flux at the shock is proportional to $\cos\theta$. (5) The temperature in the shock layer is constant. Author

N66-33262# Aerospace Corp., San Bernardino, Calif.

NUMERICAL CALCULATIONS OF ARBITRARY MULTIDIMENSIONAL AND UNSTEADY FLOWS BY THE METHOD OF CHARACTERISTICS

Harry Sauerwein May 1966 66 p refs
(Contract AF 04(695)-669)
(TR-669(S6815-71)-2; BSD-TR-66-169; AD-633958)

The analytic and numerical procedures necessary to write a general method of characteristics computer code are presented. The theory of characteristics is applied to the partial differential equations of an inviscid fluid. The geometry of the characteristics is determined. A procedure for finite-differencing the compatibility equations is developed and the stability and convergence of the procedure is analyzed. The details of the finite difference network and of a successful organization of the network to calculate complete flow fields are presented. The flow between a detached shock wave and the surface of a two-dimensional body in unsteady motion has been calculated. The results of several calculations of specific body motions are presented in the form of velocity vector plots and contours of constant values of the dependent variables at various times during the calculation. From the results it is concluded that practical calculations of multidimensional unsteady flows can be accomplished with an extension coding effort and a reasonable amount of computer time. Ways for improving the accuracy and the general applicability of the method of characteristics have been discovered and these help to increase the general utility of the method. Author (TAB)

N66-33298# Brown Univ., Providence, R. I. Div. of Engineering.

ON THE MOTION OF AN INFINITE PLATE IN A VISCOUS COMPRESSIBLE FLUID WITH SMALL RADIATIVE HEAT TRANSFER

H. C. Kung Apr. 1966 48 p refs

(Contract Nonr-562(35))

(Nonr-562(35)/14; AD-633961) CFSTI: HC $2.00/MF $0.50

The flow of a viscous, compressible, heat conducting fluid near an impulsively started infinite flat plate is considered in the limiting case of a weakly radiating gray gas. The plate is thermally insulated. The time is restricted to be of the order of the ratio of photon mean free path to plate velocity, and the Reynolds number based on photon mean free path must be large compared with M6 (M is Mach number of the plate). Then the flow field is separated into two asympotitically significant regions: a viscous boundary layer and an inviscid outer region. The smallness of the radiation-convection ratio enables us to compute the radiation-perturbed flow field as an iteration on the radiationless solution. For an optically thick gas (optically finite boundary layer), the author finds that the effect of thermal radiation is limited to the boundary layer. Radiative transport lowers the temperature of the fluid close to the plate and raises the temperature of the fluid away from the plate. For an optically finite gas (optically thin boundary layer), the temperature of the fluid very close to the plate is substantially lowered, the fluid in the rest of the boundary layer is heated by radiation, and there are waves propagating in the outer region due to the radiative heat flux from the boundary layer. Author (TAB)

N66-33439* Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.

FORCED SOUND PROPAGATION INDUCED BY A FRACTIONALLY ACCOMMODATING PISTON

R. J. Mason [1965] 21 p refs

(Grant NsG-496)

(NASA-CR-77047) CFSTI: HC $1.00/MF $0.50 CSCL 20A

This paper examines the steady state sound disturbances induced in a semi-infinite gas by an oscillating plane piston which reflects a fraction, σ, of the incoming particles specularly and the remaining fraction, $1-\sigma$, diffusely and isothermally. In the frame of the moving boundary the diffusely reflected particles come off with a Maxwellian distribution at the background gas temperature. The specular case ($\sigma=1$) was examined by the present author and also separately by H. Weitzner for the 1964 symposium of this series. The present work generalizes these earlier treatments. Author

N66-33447*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

PRESSURE DISTRIBUTIONS DUE TO TWO-DIMENSIONAL FABRICATION-TYPE SURFACE ROUGHNESS ON AN OGIVE CYLINDER AT TRANSONIC SPEEDS

K. R. Czarnecki and William J. Monta Washington, NASA, Aug. 1966 81 p refs

(NASA-TN-D-3516) CFSTI: HC $3.00/MF $0.75 CSCL 01A

An investigation has been made in the transonic Mach number range from 0.70 to 1.20 and over a range of free-stream Reynolds number per foot from about 0.8×10^6 to 6.0×10^6 to determine the pressure distributions over essentially two-dimensional fabrication-type surface roughness immersed in a turbulent boundary layer. Six types of surface roughness, including step, wave, crease, and swept configurations, were investigated. The tests were made on an ogive cylinder of fineness ratio 12.2, the roughness elements covering the cylindrical portion of the model. The results have been examined with the objective of establishing the basic types of flow phenomena over the roughness elements so that the proper theoretical and empirical methods of investigating the phenomena of roughness drag in more detail can be delineated. Examination of the subsonic results in the form of longitudinal pressure distributions did not indicate the process by which drag is generated subsonically, but did show the need for developing theories for predicting pressure for arbitrary roughness shapes at these speeds. At transonic and supersonic Mach numbers, the pressure distributions indicated the generation and expansion of local supersonic flows over the roughness elements with the onset of supersonic wave drag. Author

N66-33449*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

PRESSURE DRAGS DUE TO TWO-DIMENSIONAL FABRICATION-TYPE SURFACE ROUGHNESS ON AN OGIVE CYLINDER AT TRANSONIC SPEEDS

K. R. Czarnecki and William J. Monta Washington, NASA, Aug. 1966 57 p refs

(NASA-TN-D-3519) CFSTI: HC $3.00/MF $0.50 CSCL 01A

An investigation has been made in the transonic Mach number range from 0.70 to 1.20 and over a range of free-stream Reynolds number per foot from about 0.8×10^6 to 6.0×10^6 (2.6×10^6 to 20×10^6 per meter) to determine the pressure drags due to essentially two-dimensional fabrication-type surface roughness immersed in a turbulent boundary layer. Six types of surface roughness, including step, wave, crease, and swept configurations were investigated. The tests were made on an ogive cylinder of fineness ratio 12.2, the roughness elements covering the cylindrical portion of the models. The results indicated that at subsonic free-stream Mach numbers all roughness elements had a pressure or form drag. At sufficiently high subsonic and/or supersonic Mach numbers wave drag appeared and became a major component of the total roughness-element drag. The rise in wave drag in the transition from subsonic to supersonic flow was somewhat earlier, more abrupt, and larger in magnitude at the forward stations than at the rearward stations. Sweepback of the roughness elements delayed markedly the onset of compressibility effects and appeared to limit the drag coefficients to lower values than those for the unswept configurations. Effects of Reynolds number per foot (per meter) were usually

very small at subsonic speeds and at a maximum when the roughness-element drags were at a maximum at supersonic speeds. Author

N66-33469# Brown Univ., Providence, R. I. Div. of Applied Mathematics.

A CRITICAL SURVEY OF LITERATURE CONCERNING THE TOMS' EFFECT

Cipher A. Deavours May 1966 42 p refs

(Contract Nonr-562(42))

(TR-1; AD-634529) CFSTI: HC $2.00/MF $0.50

Literature on the Toms' effect, i.e., greatly increased flow rate of dilute polymer solutions occurring with small increases in solute concentration, is examined. Several existing theories dealing with the phenomena are reviewed, appraised, and modified. Work from related fields is analyzed for its applicability to the situation and an effort is made to suggest future lines of study. Author (TAB)

N66-33486# California Univ., Berkeley. Coll. of Engineering.

AN EXPERIMENTAL STUDY OF SHIP RESISTANCE AND MOTIONS IN WAVES: A TEST FOR LINEAR SUPERPOSITION

Osvald J. Sibul Jan. 1966 28 p refs

(Contract Nonr-3656(16))

(NA-66-3; AD-634330) CFSTI: HC $2.00/MF $0.50

A series of experiments were performed to check the linear superposition of resistance of component waves on a composite wave. A wave train, having only two components of uniform waves, was generated. The resistance in each of the wave components was measured and the linear superposition of this data compared with measurements in the composite wave. The results indicate that the linear superposition underestimates the resistance in the composite wave. The degree of underestimation depends upon the severity of the ship motions. With slamming and with green water on the deck, the predicted resistance, based on linear superposition, was considerably less than the actual measurement. For moderate waves and smooth motions the difference was smaller.

Author (TAB)

N66-33495*# Louisiana State Univ., Baton Rouge. Div. of Engineering Research.

FLOW LOSSES IN FLEXIBLE HOSE Quarterly Progress Report No. 4, Mar. 14–Jun. 14, 1965

Charles A. Whitehurst Jun. 1966 72 p refs

(Contract NAS9-4630)

(NASA-CR-65433) CFSTI: HC $2.50/MF $0.75 CSCL 20D

Establishment of an empirical method for predicting flow losses in flexible hose while using a gas (air) and a liquid (water) as the test mediums is discussed. The effect of straight sections and sections with bending are considered. Other considerations are hose characteristics such as types of material and convolutions, convolution/unit length, convolution heights, diameter, bend angle, and the geometric factors. The results of a literature survey are presented and discussed. Testing techniques are briefly reviewed, and an equation expressing the friction factor is given. Data production and correlation for the water and air system constitutes the major portion of the present work. Computer programs and subprograms for the calculation of flow rate, Reynolds number, pressure drop, friction factor, and other pertinent data are included and are written in Fortran. K.W.

N66-33506# Naval Weapons Lab., Dahlgren, Va.

DECAY OF A DISCONTINUITY LINE IN A VISCOUS FLUID

Hans J. Lugt May 1966 45 p refs

(NWL-2038; AD-634163) CFSTI: HC $2.00/MF $0.50

Integral transforms are used to solve singular initial value problems for Stokes' slow-motion equations. The method is applied to investigate the decaying process of straight and circular discontinuity lines as well as the dissipation of local disturbances in an infinite medium. A criterion for the occurrence of secondary vortices is derived. Numerical results are displayed for periodic initial disturbances which demonstrate graphically the spreading of the disturbance from a discontinuity line into the fluid under successive development and decay of secondary vortices. A more detailed sequence of dissipating vortices is evaluated numerically and displayed by streamline patterns in connection with Lamb's vortical Eigenmotions in an infinitely long cylinder of finite radius.

Author (TAB)

N66-33515# Maryland Univ., College Park.

A CRITICAL SURVEY OF MAGNETOFLUID DYNAMICS. PART IV: MODERN ASPECTS OF MAGNETOFLUID DYNAMICS (TENSOR ELECTRICAL CONDUCTIVITY AND MULTIFLUID THEORY)

Shih-i Pai Wright-Patterson AFB, Ohio, ARL, Mar. 1966 64 p refs

(Contract AF 33(657)-7805)

(ARL-66-0060; AD-634521) CFSTI: HC $3.00/MF $0.75

This report gives a critical survey of modern aspects of magnetofluid dynamics (mfd) based on multifluid theory with special emphasis on the new features different from the classical magnetofluid dynamics. First the fundamental equations of multifluid theory of MFD are discussed and their effects on the electrical current density, the Hall current, and ion slip are treated. Then we re-examine many typical flow problems of MFD with tensor electrical conductivity or by multifluid theory, which include quasi-one dimensional flow, MFD channel flow, Rayleigh flow, linearized theory, wave motion, boundary layer flow, heat transfer problem, and electrical characteristic of Langmuir type probe. These results are compared with those obtained by classical MFD single fluid theory with scalar electrical conductivity. Author (TAB)

N66-33571# Lockheed Missiles and Space Co., Palo Alto, Calif.

INFLUENCE OF DISSOCIATION ON THE SURFACE FRICTION IN A TURBULENT BOUNDARY LAYER

B. I. Lomashev and N. I. Vasil'ev [1966] 12 p refs Transl. into ENGLISH from Izv. Akad. Nauk Belorussk. SSR, Ser. Fiz.-Tekhn. (Minsk), no. 2, 1966 p 42–49

A solution is given of the boundary layer equation for two-component (molecule–atom) gases at high speeds and high temperatures. A molecule plus molecule mixture of N_2O_4 and NO_2 is considered in the 350° K to 450° K temperature range and with $M \leq 1$. It assumed that the gas mixture is obtained as a result of dissociation of certain molecules. The N_2O_4 and NO_2 components are in chemical equilibrium, and react reversibly at a given temperature and pressure according to the law $N_2O_4 \rightleftarrows NO_2 + NO_2$. The relative quantity of the N_2O_4 and NO_2 components for this mixture are characterized by the degree of dissociation. C.T.C.

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N66-33613# State Univ. of Iowa, Iowa City. Inst. of Hydraulic Research.

THE EFFECT OF THE FREE SURFACE ON THE DRAG OF SUPERCAVITATING AXISYMMETRIC BODIES Final Report

Arthur D. Newsham Dec. 1965 25 p refs
(Contract Nonr-1509(05))
(AD-630203) CFSTI: HC $1.00/MF $0.50

The drag force on three supercavitating axisymmetric bodies—a disk, a 90° cone and a 2:1 ellipsoid truncated at 25% of its length—was investigated for varying values of the cavitation coefficient, Froude number, and submergence. The results are compared with existing experimental data for similar bodies deeply submerged and with a theoretical solution for a disk. TAB

N66-33629# California Inst. of Tech., Pasadena.
THE EFFECT OF WALL ELASTICITY AND SURFACE TENSION ON THE FORCED OSCILLATIONS OF A LIQUID IN A CYLINDRICAL CONTAINER
P. Tong and Y. C. Fung [1965] 40 p refs Presented at the Symp. on Fluid Mech. and Heat Transfer under Low Gravitational Conditions, Palo Alto, Calif., 24–25 Jun. 1965; sponsored by U.S. AF Office of Sci. Res. and Lockheed Missiles and Space Co.
(AD-633765)

The stability of a fluid contained in a circular cylindrical tank with a flat, flexible bottom under a periodic axial excitation is studied. A variational approach is formulated. An approximate solution results in a pair of coupled ordinary differential equations with periodic coefficients. A method of handling the stability of the solutions of such a system of equations is presented, numerical results are discussed.
Author (TAB)

N66-33631# North American Aviation, Inc., Anaheim, Calif. Ocean Systems Operations.
A NEW METHOD FOR PREDICTION OF STABILITY OF LAMINAR BOUNDARY LAYERS Interim Report
John R. Radbill and Edward R. van Driest Feb. 1966 108 p refs
(Contract AF 49(638)-1442)
(C6-1019/020; AFOSR-66-0702; AD-633978) CFSTI: HC $4.00/MF $0.75

A new method for predicting the stability of laminar boundary layers is described. The quasi-linearization method is used to compute eigenfunctions and eigenvalues for the complete Orr–Summerfeld equation. Remarkable agreement is found between the computed shape of the Tollmien–Schlichting wave and the data of Schubauer and Skramstad. A computed neutral stability curve shows better agreement with the data of Schubauer than do the theoretical curves of Schlichting or Shen. The method is important because it can be used to study nonlinear effects which are believed to lead to turbulence.
Author (TAB)

N66-33661# Polytechnic Inst. of Brooklyn, Farmingdale, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.
AN EXPERIMENTAL INVESTIGATION OF THREE-DIMENSIONAL FREE MIXING IN INCOMPRESSIBLE, TURBULENT, FREE JETS
Nicholas Trentacoste and Pasquale M. Sforza Mar. 1966 76 p refs
(Contract AF 49(638)-1623)
(PIBAL-871; AFOSR-66-6651; AD-634254) CFSTI: HC $3.00/MF $0.75

An experimental investigation of the bulk properties of turbulent, three-dimensional, incompressible, air jets issuing into a quiescent air ambient is presented. The jet orifices utilized included rectangular, elliptical, axisymmetric and triangular geometries. Experimental results of pertinent mean flow properties such as axis velocity decay, halfwidth growth, etc., are reported. The flow fields of such jets are found to be characterized by three distinct regions in the axis velocity decay. The results obtained lead to the conclusion that low-speed jets which originate from nonaxisymmetric orifices decay to axisymmetry far downstream of the jet exit.
Author (TAB)

N66-33669*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HYDRODYNAMICS OF LIQUID SURFACES
Edward W. Otto *In its* Selected Technol. for the Petrol. Ind. 1966 p 45–65 refs (See N66-33666 19-34) GPO: HC $1.25; CFSTI: MF $0.50

Research on the dynamic behavior of liquids and gases in a zero gravity environment with respect to propellants and liquids in space vehicles during coasting flight is reviewed. The hydrodynamic phenomena that are strongly influenced by surface tension forces are discussed, and special emphasis is placed on the fluid behavior in terms of the fluid properties and other physical constants of the system. Zero-gravity facilities described are the drop tower, airplane, and rocket facilities. The interface statics in cylinders and spheres, and the influence of baffles are covered. The interface dynamics are discussed, and data on the interface formation time following change in acceleration level are presented. Details on the interface behavior during outflow and acceleration disturbances are given. Graphs are included for surface tension–acceleration, stability characteristics for vertical and horizontal cylinders and different accelerations, and penetration velocity of ullage vapor during collection. N.E.N.

N66-33686*# National Aeronautics and Space Administration, Washington, D. C.
MEASUREMENTS OF THE INTENSITY OF TURBULENCE IN A GAS FLOW BY THE THERMOELECTRIC METHOD [IZMERENIYA INTENSIVNOSTI TURBULENTNOSTI V GAZOVOM POTOKE TERMOELEKTRICHESKIM METODOM]
A. I. Bannikov Jun. 1966 12 p refs Transl. into ENGLISH from Energ. i Elektrotekhn. Prom. (Kiev), No. 3, 1964 p 32–33
(NASA-TT-F-10223) CFSTI: HC $1.00/MF $0.50 CSCL 20D

A thermoelectric method for measuring velocity fluctuations and turbulence in a gas flow, by determining the fluctuating portion of the dynamic component of the stagnation temperature at constant recovery factor, is described, with a flow diagram of the device. The method is applicable to measurements in pilot and full-scale installations and permits filtering out the velocity fluctuations from the temperature fluctuations.
Author

N66-33692*# National Aeronautics and Space Administration, Washington, D. C.
RECENT RESULTS IN THE STUDY OF PROBLEMS OF MIXING AND REATTACHMENT [RESULTATS RECENTS DANS L'ETUDE DES PROBLEMES DE MELANGE ET DE RECOLLEMENT]
Pierre Carrière and Maurice Sirieix Jun. 1966 25 p refs Transl. into ENGLISH of the XIth Intern. Congr. on Appl. Mech. held at Munich, 30 Aug.–5 Sep. 1964 ONERA T. P. No. 165 (NASA-TT-F-10203) CFSTI: HC $1.00/MF $0.50 CSCL 20D

Experiments on conical separation carried out in the almost complete absence of perturbation have confirmed that the Chapman–Korst criterion of turbulent seperation must be modified. Work carried out in plane flow and flow of revolution, in the presence of an initially turbulent boundary layer

of negligible thickness, leads to the same conclusion. It is not yet possible to exactly construct a criterion of separation encompassing all the results obtained, but an approximate approach is proposed that differs greatly from that of Chapman–Korst. Author

N66-33697*# National Aeronautics and Space Administration, Washington, D. C.

MOTION OF A RIGID BODY UNDER THE EFFECT OF ROTATION OF AN INTERNAL FLYWHEEL [K DVIZHENIYU TVERDOGO TELA POD DEYSTVIYEM VRASHCHENIYA VNUTRENNEGO MAKHOVIKA]

B. A. Smol'nikov May 1966 13 p refs Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), v. 28, no. 1, 1964 p 171–174

(NASA-TT-F-10139) CFSTI: HC $1.00/MF $0.50 CSCL 20D

The solution of the problem of the finite rotation of an asymmetric solid under the effect of rotation of an internal flywheel whose axis is arbitrarily fixed in the body is examined. It is shown that in the general case of rotation of the flywheel about an arbitrary axis, the supporting body executes pure rotation about another axis known as the associate axis. Formulas are derived for determining the direction of the axis of the flywheel fixed in the body with respect to a given magnitude of the three-dimensional rotation of the supporting body. Author

N66-33706# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Munich (West Germany). Institut für Elektronen- und Ionenforschung.

INVESTIGATIONS ON THE INTERACTION BETWEEN RAREFIED GASES AND SOLID SURFACES [UNTERSUCHUNGEN DER WECHSELWIRKUNG VERDUNNTER GASE MIT FESTEN OBERFLAECHEN]

Waldemar Jawtusch and Alexander Nikuradse Feb. 1966 49 p refs In GERMAN; ENGLISH summary

(DLR-FB-66-18) CFSTI: HC $2.00/MF $0.50

The scattering of molecular beams of the rarefied gases argon, hydrogen and air by solids, e.g., glass, mica and silver was investigated. The increase of the extent of this scattering which is interpreted as a decrease of the momentum loss respectively of the friction drag, appeared to depend on the state of the gas, the angle of incidence of the primary beam, and the state of the solid substance (surface temperature, preparatory treatment such as the effect of hydrogen gas, mechanical properties, e.g. roughness). Author

N66-33713*# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.

FLOW FIELD COMPUTER PROGRAM Final Report

G. Waldman 22 May 1964 54 p refs

(Contract NAS9-2494)

(NASA-CR-65434; RAD-TR-64-17) CFSTI: HC $2.50/MF $0.50 CSCL 20D

The method of integral relations has been applied to the flow over a blunt axisymmetric body at moderate angle of attack. A one-strip analysis is developed for a perfect gas or equilibrium air. A machine program has been written based on this analysis, and results of the program are presented. Author

N66-33724*# National Aeronautics and Space Administration, Washington, D. C.

AN UNSTEADY THERMAL LAMINAR BOUNDARY LAYER ON A SEMI-INFINITE PLATE IN A VISCOUS FLOW [NESTATSIONARNYY TEPLOVOY LAMINARNYY POGRANICHNYY SLOY NA POLUBESKONECHNOY PLASTINKE, OBTEKAYEMOY VYAZKOY ZHIDKOST'YU]

Yu. L. Rozenshtok Jun. 1966 17 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Mekhan. (USSR), no. 6, 1965 p 20–26

(NASA-TT-6-10214) CFSTI: HC $1.00/MF $0.50 CSCL 20D

The Karman–Pohlhausen method is applied to the processes of formation of a thermal laminar boundary layer on a semi-infinite isothermal plate impulsively set in uniform motion in a viscous incompressible fluid. Analysis of the processes occurring during the formation of a boundary layer for Prandtl numbers $\sigma > 1$ and $\sigma < 1$ indicates that two fronts where velocity and temperature profiles reach a steady state are present, namely a hydrodynamic front and a thermal front. The velocity of motion of the thermal front, which leads the dynamic front for $\sigma < 1$ and lags behind it for $\sigma > 1$, is found to be a function of the Prandtl number and is determined by various functional relations for $\sigma < 1$ and $\sigma > 1$. The solutions obtained for the velocity of motion of the thermal front in various ranges of Prandtl numbers for $\sigma = 1$ become the analogous relations for the velocity of motion of the dynamic front. It is further shown that the solution to the problem of the formation of a thermal boundary layer, using an assumption of a stationary velocity distribution as a preliminary condition, is applicable only to the case $\sigma > 1$, since for $\sigma < 1$ this assumption gives only the steady-state portion of the general solution. Author

N66-33783# California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.

RECTIFIED INTERNAL CONVECTION AND ULTRASONIC CAVITATION IN HELIUM II

Din-Yu Hsieh Apr. 1966 21 p refs

(Contract Nonr-220(28))

(Rept.-85-33; AD-483200)

The low cavitation threshold pressure of He_2 and its peculiar temperature dependence is analyzed on the basis of two-fluid hydrodynamic equations. The mechanism of rectified internal convection for an oscillating bubble is suggested as a possible explanation for the observed phenomena. Based on this idea, simple theoretical model is constructed to calculate the threshold pressure. The theoretical values agree fairly well with the experimental data, and they exhibit similar temperature dependence. Author (TAB)

N66-33844# General Dynamics Corp., San Diego, Calif. Special Nuclear Effects Lab.

PRODUCTION OF STRONGLY OVERDRIVEN PLANE DETONATION WAVES IN CONDENSED EXPLOSIVES Final Report

Brian Dunne 1 Nov. 1965 37 p refs

(Contract DA-49-146-XZ-426)

(GA-6798; DASA-1729; AD-634017) CFSTI: HC $2.00/MF $0.50

Experiments are described in which a hemispherical detonation wave was gradually transformed into a strongly overdriven plane wave by the use of a high-density confinement nozzle. The resulting wave had a peak pressure of up to two times the Chapman–Jouguet value and a planarity of ±1mm over a 4.3 cm diameter. Author (TAB)

N66-33972*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

AN ANALYSIS OF SUPERSONIC FLOW PHENOMENA IN CONICAL NOZZLES BY A METHOD OF CHARACTERISTICS

Linwood B. Callis Washington, NASA, Aug. 1966 52 p refs

(NASA-TN-D-3550) CFSTI: HC $2.00/MF $0.50 CSCL 20D

The method of axisymmetric irrotational characteristics is used in the analysis of the supersonic and hypersonic flow of a calorically perfect gas through conical nozzles. Solutions determine the Mach number, flow angularity, and stream function throughout the flow field in addition to the nozzle lengths and cone half-angles required for the expansion of the flow to a given center-line Mach number. Calculations carried out for a wide range of inlet Mach numbers and cone half-angles allow, as in previous work, the prediction and explanation of the formation of oblique shock waves within the started nozzle. By using a characteristics method, shock-free solutions are obtained with minimum distortion of the conical profile. Typical Mach number contours with shock waves eliminated are shown. An evaluation of the commonly made one-dimensional-flow assumption as applied to conical nozzles is made, and it is shown that significant errors may be present. Finally, the existence of regions in which the flow properties prove to be independent of changes in the cone half-angle is pointed out and its importance is described and discussed. Author

N66-33980*# National Aeronautics and Space Administration, Washington, D. C.

ON THE QUESTION OF CALCULATION OF RADIATION IN ONE-DIMENSIONAL MOVEMENT OF MONATOMIC GAS [KVOPROSU OB UCHETE IZLUCHENIYA PRI ODNOMERNOM STATSIONARNOM DVIZHENII ODNOATOMNOGO GAZA]

V. A. Prokof'yev Aug. 1966 132 p refs Transl. into ENGLISH from Sci. Record of Moscow State Univ. (USSR), v. 179, 1954 p 79–124

(NASA-TT-F-10500) CFSTI: HC $3.00/MF $1.00 CSCL 20D

Hydrodynamic equations are used in calculations designed to examine the effect on the characteristics of a stream of radiation and ionization in a one-dimensional movement of monatomic ideal gas. A system of equations describing the movement of a solid medium (a transfer of a quantity of movement equation, a transfer of mass equation, and a transfer of energy equation) are worked out and are then applied to the one-dimensional movement of the material in a radiation field; and to the same type of problem with a heat influx occurring due to the radiation itself. The calculations are quite detailed; and several curves relating the parameters of pressure, temperature, entropy, specific heats, degree of ionization, density, coefficient of opacity, and speed of the waves considered in the calculations are depicted. L.S.

N66-33989# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.

A PROGRAM OF TWO-PHASE FLOW INVESTIGATION Quarterly Report No. 12, Jan.–Mar. 1966

F. W. Staub and N. Zuber 1 Apr. 1966 45 p refs

(Contract AT(04-3)-189)

(GEAP-5142; EURAEC-1628) CFSTI: HC $2.00/MF $0.50

The experimental data at oscillating heat input and at a reduced pressure of 0.4 was completed in this period. Power oscillation amplitudes were at 25% and 40%, respectively, in a 0.05 to 10 cps frequency range. The percent of test section length required to remove inlet subcooling, based on thermodynamic equilibrium, was varied from 3% to 70%. Only a few runs were carried out with large inlet subcooling in order to acquire such data for future reference, as well as to indicate the order of magnitude effects of inlet subcooling on the dynamic behavior of the two-phase flow at this reduced pressure. The experimental dynamic void behavior is compared with the solution obtained from the propagation equation. The same comparison is thus made at a reduced pressure of 0.4 as was previously given at lower reduced pressures. A general method of analysis was developed to test for the stability of a two-phase system. Since stability criteria consisting of groups of independent variables will result from this formulation, they will first be compared to data with and without relative phase velocity to find whether these criteria are significantly affected by the relative velocity. If the present experimental rig can obtain information against which these criteria can be tested, recommendations for some revision of the planned test program will be made. Author (NSA)

N66-34030# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CALCULATION OF A TURBULENT SUBMERGED STREAM OF REAL GAS

V. I. Bakulev 29 Apr. 1966 20 p refs Transl. into ENGLISH from Inzh. Zh. (USSR), v. 1, no. 3, 1961 p 65–74

(FTD-TT-65-1923/1+2+4; TT-66-61199; AD-632285) CFSTI: HC $1.00/MF $0.50

In this report is given a solution of a problem concerning boundary layer of the initial section of a plane-parallel stream of real gas with low temperature. The solution is based on the theory of free turbulence by Prandtl with the assumption, that the length of the displacement way in scalar values is greater than the vectorial values. For comparison are given calculations by Taylor's theory of free turbulence, in which it is assumed, that the tangent turbulent stresses are determined by the lateral transfer of wings and not by the amount of movement, as in the case of Prandtl. Author (TAB)

N66-34071*# Southwest Research Inst., San Antonio, Tex. Dept. of Mechanical Sciences.

[FUEL SLOSHING STUDIES] Quarterly Progress Report No. 15, 1 Oct.–31 Dec. 1965

H. Norman Abramson 8 Jan. 1965 11 p ref

(Contract NAS8-1555)

(NASA-CR-77093) CFSTI: HC $1.00/MF $0.50 CSCL 20D

A preliminary discussion of data from tests to determine pressure distributions on a single solid ring baffle is presented. Plots of the data indicate that the peak pressure (at the first liquid resonance, in the plane of excitation) varies almost linearly with the excitation amplitude. Agreement between measured pressures across the baffle in the plane of excitation and a theory based on measurements of slosh height and resonance frequency is considered to be excellent. Calibration of the experimental apparatus and the associated electronic equipment for measuring torque, and the phase angle between torque and displacement, in a pitching cylindrical tank is reported near completion. N.E.N.

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N66-32718# Joint Publications Research Service, Washington, D. C.

TRANSLATIONS ON COMMUNIST CHINA: SCIENCE AND TECHNOLOGY, NO. 325

1 Jul. 1966 43 p refs Transl. into ENGLISH of 2 Articles from Acth. Met. Sinica (Peking)
(JPRS-36303; TT-66-32735) CFSTI: $2.00

CONTENTS:

1. THE DISTRIBUTION OF TOTAL ANNUAL AND SEASONAL INSOLATION IN CHINA W.-c. Hsiao p 186–190 (See N66-32719 19-13)

2. CHARACTERISTICS OF THE DISTRIBUTION OF TOTAL RADIATION IN CHINA T.-k. Tso p 78–96 (See N66-32720 19-13)

N66-32719# Joint Publications Research Service, Washington, D. C.

THE DISTRIBUTION OF TOTAL ANNUAL AND SEASONAL INSULATION IN CHINA

Wen-chun Hsiao *In its* Transl. on Communist China: Sci. and Technol., No. 325 1 Jul. 1966 p 1–10 refs Transl. into ENGLISH from Acta. Met. Sinica (Peking), v. 30, no. 2, May 1959 p 186–190 refs (See N66-32718 19-13) CFSTI: $2.00

This paper based on analysis of data on insolation observed by all of China's 26 observatories and stations, from December 1957 to November 1958, includes maps of China's seasonal and total annual radiation distribution, which are even bigger than those of America and the whole world. The latest discussion is of the accuracy of all kinds of empirical formulas in different climatic conditions, and suggests that different empirical formulas be applied in different climatic regions. Author

N66-32720# Joint Publications Research Service, Washington, D. C.

CHARACTERISTICS OF THE DISTRIBUTION OF TOTAL RADIATION IN CHINA

Ta-K'ang Tso *In its* Transl. on Communist China: Sci. and Technol., No. 325 1 Jul. 1966 p 11–36 refs Transl. into English from Acta. Met. Sinica (Peking), v. 33, no. 1, Feb. 1963 p 78–96 (See N66-32718 19-13) CFSTI: $2.00

In this paper, all the known empirical formulas for the calculation of total solar radiation are reviewed and evaluated. By using the observation and calculation data, the distribution maps of the annual and monthly total radiation of China are drawn. The characteristics of the three-dimensional distribution of the annual and monthly total radiation are discussed. The total solar radiation is the main energy source at the earth's surface. Moreover, this is also an important component of radiative equilibrium and heat equilibrium at the earth's surface. When studying the hydrothermal conditions at the earth's surface, processes of natural geography, conversion of solar radiation energy and some phenomena in the natural environment, conditions of total solar radiation should be first understood in order to reveal the nature of the physical processes. The purpose of this paper is to explain the total solar radiation and the characteristics of the three-dimensional distribution. Author

N66-32722*# TRW Systems, Redondo Beach, Calif. Space Sciences Lab.

SURVEY OF VLF ELECTRIC FIELDS IN THE MAGNETOSPHERE WITH THE POLAR ORBITING SPACECRAFT, 1964-45A

F. L. Scarf, G. M. Crook, and R. W. Fredricks [1965] 66 p refs Submitted for Publication
(Contract NASw-1226)
(NASA-CR-71708; TRW-4455-6002-RU-000) CFSTI: HC $2.50/MF $0.75 CSCL 04A

The VLF electrometer on a satellite, sampled ambient electric fields in the frequency range 1.7–14.5 kc/s. Tape recorded data for sixteen full orbits were obtained. A complete description of the experiment is given and all of the results are displayed and analyzed. It is argued that the observed fields generally represent electrostatic plasma oscillations in the ambient medium, and various sources of the large non-equilibrium noise enhancements are considered. It is noted that d-c electric fields parallel to the geomagnetic field lines (possibly associated with the flute instability) could produce the large amplitude plasma oscillations and related phenomena. Author

N66-32758*# Kansas Univ., Lawrence. Engineering Science Div.

USE OF ORBITAL RADARS FOR GEOSCIENCE INVESTIGATIONS

J. W. Rouse, Jr., W. P. Waite, and R. L. Walters Jan. 1966 33 p refs Presented at 3d Space Congr., Cocoa Beach, Fla., 7–9 Mar. 1965
(Contract NSR-17-004-003)
(NASA-CR-76895; CRES-61-8) CFSTI: HC $2.00/MF $0.50 CSCL 08B

Radar in the fields of scatterometry, altimetry, imagery, and penetration is described as a usable tool for obtaining geoscience information. Scatterometry, a newly defined field dealing with the scattering coefficients of terrain targets, is discussed. The radar cross section per unit area, or scattering coefficient, parameter contains all the geoscience information about the illuminated terrain that the radar is capable of sensing, except for location. The effect of surface texture or roughness on the magnitude of the scattering coefficient is discussed. Several radar images are examined which contain information applicable to geology, agriculture, and sea-ice studies. Vegetation penetration is described as the best use for the penetrating capability of radar. Applications of radar altimetry for determining sea slope, height of tides and storm surges, orbit calculation, and in glaciology are evaluated. S.P.

N66-32789# Joint Publications Research Service, Washington, D. C.

STUDIES IN PHYSICS OF THE ATMOSPHERE AND OCEAN

14 Jul. 1966 82 p refs Transl. into ENGLISH from Fiz. Ath. i Okeana (Moscow), v. 2, no. 4, 1966 p 367–401
(JPRS-36482; TT-66-32914) CFSTI: $3.00

CONTENTS:

1. THE THREE-DIMENSIONAL STRUCTURE OF THE LONG-WAVE RADIATION FIELD OF THE EARTH M. S. Malkevich p 1–16 refs (See N66-32790 19-13)

2. BALLOON INVESTIGATIONS OF THE RADIATIVE FLUXES IN THE FREE ATMOSPHERE K. Ya. Kondrat-yev, G. A. Nikol'skiy, and Ye. N. Yesipova p 17–32 refs (See N66-32791 19-13)

3. THE CHARACTER AND VELOCITY OF FALL OF A SYSTEM OF PARTICLES OF IDENTICAL SIZES V. G. Khorguani p 33–44 refs (See N66-32792 19-13)

4. METHODS AND EVALUATION OF INTENSIFICATION OF PRECIPITATION DURING A COLD HALF-YEAR PERIOD IN THE UKRAINIAN STEPPE M. P. Leonov p 45–59 refs

5. THE THEORY OF PERIODICAL WIND-DRIVEN CURRENTS IN A HOMOGENEOUS OCEAN V. S. Belyayev p 60–71 refs

N66-32790# Joint Publications Research Service, Washington, D. C.

THE THREE-DIMENSIONAL STRUCTURE OF THE LONG-WAVE RADIATION FIELD OF THE EARTH

M. S. Malkevich *In its* Studies in Phys. of the Atmosphere and Ocean 14 Jul. 1966 p 1–16 refs (See N66-32789 19-13) CFSTI: $3.00

Obtained are the relations between the statistical characteristics of the three-dimensional structure of the earth long wave radiation field and the fields of temperature, humidity, and cloudiness. A procedure is described which filters out high-frequency variations of meteorological fields as radiation propagates through the atmosphere. Author

N66-32791# Joint Publications Research Service, Washington, D. C.

BALLOON INVESTIGATIONS OF THE RADIATIVE FLUXES IN THE FREE ATMOSPHERE

K. Ya. Kondrat'yev, G. A. Nikol'skiy, and Ye. N. Yesipova *In its* Studies in Phys. of the Atmosphere and Ocean 14 Jul. 1966 p 17–32 refs (See N66-32789 19-13) CFSTI: $3.00

From the data of four flights with a complex of actinometric instruments using high-altitude balloons, the regularities of vertical profiles of the radiation balance and of all its components in the daytime at altitudes up to 25–32 km were analyzed. Data is presented which illustrates the relationship between various components of the radiation balance. Results of computations of the radiative measurements of temperature which reveal a considerable mutual compensation of heat radiative flux divergence caused by shortwave and long-wave radiation are discussed. Data from measurements of the direct solar radiation are used for computation of aerosol extinction and to analyze the vertical profile of the atmospheric aerosol components. Author

N66-32792# Joint Publications Research Service, Washington, D. C.

THE CHARACTER AND VELOCITY OF FALL OF A SYSTEM OF PARTICLES OF IDENTICAL SIZES

V. G. Khorguani *In its* Studies in Phys. of the Atmosphere and Ocean 14 Jul. 1966 p 33–44 refs (See N66-32789 19-13) CFSTI: $3.00

It is shown experimentally that the velocity of fall of a system of particles of identical sizes with very small Reynolds numbers exceeds by several times the velocity of fall of isolated particles. Data are presented which show how the velocity of fall of a system of particles changes depending on the overall number of particles, the distance between them, and the Reynolds numbers. Author

N66-32820# California Univ., Berkeley. Lawrence Radiation Lab.

GEOLOGIC AND GEOTECHNICAL STUDIES ON PROPOSED SITES FOR A 300 GeV ACCELERATOR [ETUDES GEOLOGIQUES ET GEOTECHNIQUES SUR LES SITES PROPOSES POUR UN ACCELERATEUR DE 300 GeV]

J. Gervaise and Ch. Mallet Mar. 1966 48 p refs Transl. into ENGLISH of CERN Report AR-INT-SG-65-28 (UCRL-TRANS-1320)

A questionnaire for aiding in selecting a site for a 300-BeV synchrotron is included. All necessary geological terms necessary for the engineer's understanding are defined and discussed in detail. Rock mechanics and mechanical borings of the selected site are discussed. NSA

N66-33090# Weapons Research Establishment, Salisbury (Australia).

IONOSPHERIC DATA FOR MARCH 1965 FROM SALISBURY, SOUTH AUSTRALIA

Feb. 1966 27 p ref

(WRE-CPD-1965/3(S)) CFSTI: HC $2.00/MF $0.50

Tables of the hourly values of the customary ionospheric parameters are given for the station at Salisbury for March 1965. Author

N66-33091# Weapons Research Establishment, Salisbury (Australia).

IONOSPHERIC DATA FOR APRIL 1965 FROM SALISBURY, SOUTH AUSTRALIA

Feb. 1966 27 p ref

(WRE-CPD-1965/4(S)) CFSTI: HC $2.00/MF $0.50

Tables of the hourly values of the customary ionospheric parameters are given for the station at Salisbury, South Australia, for April 1965. Author

N66-33094# Weapons Research Establishment, Salisbury (Australia).

IONOSPHERIC DATA FOR OCTOBER 1965 FROM SALISBURY, SOUTH AUSTRALIA

Apr. 1966 29 p ref

(WRE-CPD-1965/10(S)) CFSTI: HC $2.00/MF $0.50

Tables of the hourly values of the customary ionospheric parameters are given for the station at Salisbury for October 1965. Author

N66-33095# Weapons Research Establishment, Salisbury (Australia).

IONOSPHERIC DATA FOR SEPTEMBER 1965 FROM SALISBURY, SOUTH AUSTRALIA

Apr. 1966 23 p ref

(WRE-CPD-1965/9(S)) CFSTI: HC $1.00/MF $0.50

Tables of the hourly values of the customary ionospheric parameters are given for the station at Salisbury for September 1965. Author

N66-33096# Weapons Research Establishment, Salisbury (Australia).

IONOSPHERIC DATA FOR SEPTEMBER 1965 FROM WOOMERA, SOUTH AUSTRALIA

Mar. 1966 29 p ref

(WRE-CPD-1965/9(W)) CFSTI: HC $2.00/MF $0.50

Tables of the hourly values of the customary ionospheric parameters are given for the station at Woomera for September 1965. Author

N66-33097# Weapons Research Establishment, Salisbury (Australia).

IONOSPHERIC DATA FOR OCTOBER 1965 FROM WOOMERA, SOUTH AUSTRALIA

Apr. 1966 29 p ref

(WRE-CPD-1965/10(W)) CFSTI: HC $2.00/MF $0.50

Tables of the hourly values of the customary ionospheric parameters are given for the station at Woomera for October 1965. Author

N66-33098# Weapons Research Establishment, Salisbury (Australia).
IONOSPHERIC DATA FOR AUGUST 1965 FROM SALISBURY, SOUTH AUSTRALIA
Mar. 1966 24 p ref
(WRE-CPD-1965/8(S)) CFSTI: HC $1.00/MF $0.50

Tables of the hourly values of the customary ionospheric parameters are given for the station at Salisbury for August 1965. Author

N66-33099# Weapons Research Establishment, Salisbury (Australia).
IONOSPHERIC DATA FOR AUGUST 1965 FROM WOOMERA, SOUTH AUSTRALIA
Mar. 1966 29 p refs
(WRE-CPD-1965/8(W)) CFSTI: HC $2.00/MF $0.50

Tables of the hourly values of the customary ionospheric parameters are given for the station at Woomera for August 1965. Author

N66-33101# Weapons Research Establishment, Salisbury (Australia).
IONOSPHERIC DATA FOR JULY 1965 FROM WOOMERA, SOUTH AUSTRALIA
Feb. 1966 29 p
(WRE-CPD-1965/7(W)) CFSTI: HC $2.00/MF $0.50

Tables of the hourly values of the customary ionospheric parameters are given for the station at Woomera for July 1965. Author

N66-33118# Kakioka Magnetic Observatory (Japan).
GEOMAGNETIC AND GEOELECTRIC OBSERVATIONS, 1964 (RAPID VARIATIONS)
1966 116 p
(Rept.-5) CFSTI: HC $4.00/MF $1.00

Tabulations are presented of magnetic storms, sudden impulses, bays, solar flare effects, and pulsations observed during 1964; and examples are included of many rapid-run induction magnetograms and tellurigrams. Storm time, factors on sudden commencement, degree of activity, and maximal activity on K-scale and ranges are given. Beginning time, type, and quality of magnetic bays are shown; and beginning time, duration, quality, and occurrence time and maximum stage amplitude are tabulated for the solar flare effects. For the magnetic pulsations, the whole phenomena and individual series are given. M.W.R.

N66-33154# Joint Publications Research Service, Washington, D. C.
RESEARCH IN HYDROOPTICS
M. V. Kozlyaninov et al 3 Aug. 1966 120 p refs Transl. into ENGLISH from Gidrooptjcheskiya Issledovaniya Trudy Institut. Okeanologii Akad. Nauk SSSR (Moscow)
(JPRS-36816; TT-66-33246) CFSTI: $4.00

CONTENTS:

1. SOME BASIC PROBLEMS OF HYDROOPTICS M. V. Kozlyaninov p 1–15 refs

2. ON THE DEPENDENCE OF THE TOTAL ATTENUATION COEFFICIENT UPON SUSPENSIONS IN THE SEA Yu. Ye. Ochakovskiy p 16–24 refs

3. SOME ASPECTS OF THE THEORY OF DAYLIGHT POLARIZATION IN THE SEA V. M. Pavlov and B. N. Grechushnikov p 25–44 refs

4. SOME EXPERIMENTAL RESULTS OF THE DETERMINATION OF THE TRUE ABSORPTION COEFFICIENT OF LIGHT AT SEA V. N. Pelevin p 45–53 refs

5. ON THE APPLICATION OF A ONE-DIMENSIONAL APPROXIMATION IN THE INVESTIGATION OF THE PROPAGATION OF OPTICAL RADIATION IN THE SEA M. V. Kozlyaninov and V. N. Pelevin p 54–63 refs

6. ON THE APPLICATION OF THEORY OF SIMILARITY METHODS IN HYDROOPTICS V. N. Pelevin p 64–69 refs

7. ON THE PROBLEM OF THE ATTENUATION OF A COLLIMATED LIGHT BEAM IN THE SEA M. N. Bulkhurgin and V. P. Nikolayev p 70–75 refs

8. ON THE MEASUREMENT OF THE ANGULAR DISTRIBUTION OF SUBMARINE IRRADIANCE V. P. Nikolayev and A. A. Zhil'tsov p 76–86 refs

9. ON THE STANDARDIZATION OF MARINE PHOTOMETERS FOR MEASURING ILLUMINATION AND IRRADIATION E. M. Mezhericher p 87–92 refs

10. ON THE USE OF A CORRECTION FILTER IN MEASURING UNDERWATER ILLUMINATION V. I. Voytov and E. N. Khalemskiy p 93–97 refs

11. ON THE COMPARISON OF MEASURED AND CALCULATED SCATTERING INDICATRICES OF SEA WATER Yu. Ye. Ochakovskiy p 98–105 refs

12. ON THE CALCULATION OF SUBSURFACE ILLUMINATION E. N. Khalemskiy p 106–114 refs

N66-33155# Joint Publications Research Service, Washington, D. C.
HUNGARIAN ACHIEVEMENTS IN GEODETICS AND CARTOGRAPHY
Istvan Joo et al 1 Jul. 1966 73 p refs Transl. into ENGLISH from Geodizia es Kartografia (Budapest), No. 2, 1966 p 81–94, 98–106, 151
(JPRS-36305; TT-66-32737) CFSTI: $3.00

Recent surveying activities in Hungary are reviewed. Basic work in geodetics, map renovation, large scale surveying, topography, aerial photography, cartography, photogrammetry, and other related work are discussed. The production of geodetic instruments in Hungary, such as theodolites, tachymeters, telemeters, telescopic compass, and telescopic square is discussed, and their characteristics are described. Applications of the instruments are also discussed. In addition, an outline of activities of the Society of Geodetics and Cartography is given. L.S.

N66-33159# Federal Aviation Agency, Washington, D. C.
DEVIATIONS FROM STANDARD ALTITUDE SEPARATIONS DUE TO ATMOSPHERIC TEMPERATURE VARIATIONS Final Report
Arthur Hilsenrod Jul. 1966 35 p refs
(RD-65-12)

In order to provide a firmer basis for evaluating standards for vertical separations, e.g., permit 1,000 foot separations above 29,000 feet, a determination is made of the deviations from the assumed 1,000 foot standard vertical separations of aircraft when actual atmospheric temperature distributions are considered. Other errors contributing to the variations of vertical separation are not considered. The assumed 1,000 foot standard vertical separation is decreased to less than 900 feet with some frequency over some localities at certain times of the year at some altitudes because of the occurrence of temperatures 10% below the standard temperature. Author

N66-33177*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
ON THE EARLY HISTORY OF THE EARTH

William L. Donn (Lamont Geol. Obs.), Bertram D. Donn, and Wilbur G. Valentine (Brooklyn Coll.) [1964] 65 p refs Submitted for Publication
(NASA-TM-X-54900) CFSTI: HC $3.00/MF $0.50 CSCL 08G

This report traces the pregeologic history of the earth according to the most current astrophysical theory of the evolution of the sun and solar system from the parent solar nebula. The variation of solar luminosity with time is also considered with the suggestion that conclusions about the earliest occurrence of running water on the earth's surface may help in the calibration of the evolution of solar luminosity. Conclusions regarding the pregeologic accumulation of the earth are reviewed; accretion from cold, solid objects probably in the form of whisker-like crystals is emphasized. Data and direct conclusions relating to the oldest known rocks which have been found distributed through a roughly north–south belt in Southeast Africa, in the Kola Peninsula of northwestern USSR, in south central Manitoba, Canada, and in the Northern Rocky Mountains of the United States are described. These oldest rocks imply erosional processes back about 4 billion years ago. Astrophysical and geological conclusions derived from a consideration of the oldest rocks and modern concepts of the origin and accumulation of the earth are also described.
Author

N66-33192# Massachusetts Inst. of Tech., Cambridge. Lab. of Nuclear Science.
NOTES ON THE PRIMARY ENERGY SPECTRUM FROM 6 $\times 10^{14}$ ev TO 4 $\times 10^{17}$ ev
M. La Pointe, A. Bradt, G. Clark, V. Domingo, I. Escobar (San Andres Univ.) et al *In* Comision Nacl. de Invest. Espaciales Proc. of the Regional Symp. of the Intern. Years of the Quiet Sun, Vol. III 1965 5 p refs Prepared jointly with San Andres Univ. (See N66-33186 19-29) CFSTI: HC $4.00/MF $1.00
(Grant AF-AFOSR-546-64)

Data obtained on the primary energy spectrum of showers with particles from 6×10^{14} ev to 4×10^{17} ev using an automatic processing technique are given. A log intensity plot shows the integral size spectrum of the Bolivian Air Shower Joint Experiment (BASJE) showers at Mt. Chacaltaya (5200 m altitude) of near vertical incidence. Also shown on the same graph is similar data from the Mt. El Alto (4200 m altitude) experiment. The data agree for the large size particles, indicating that the stations are near shower maximum. Also presented are longitudinal development curves (log size versus atmospheric depth at constant intensity) based on the earlier El Alto data and on the improved Mt. Chacaltaya data. These data indicate that even for the largest showers observed at Mt. Chacaltaya, there is not indication that the station is above the shower maximum. In addition a plotted curve showing the variation of the integral shower intensity with size at maximum development, is presented. Further comments on all of the foregoing curves are noted.
L.S.

N66-33193# Alaska Univ., College. Geophysical Inst.
OBSERVATIONS AND INTERPRETATION OF PHENOMENA AT MAGNETICALLY CONJUGATE POINTS
K. B. Mather and E. M. Wescott *In* Comission Nacl. de Invest. Espaciales Proc. of the Regional Symp. of the Intern. Years of the Quiet Sun, Vol. III 1965 17 p refs (See N66-33186 19-29) CFSTI: HC $4.00/MF $1.00
(Contracts AF 19(604)-6180; AF 19(628)-2779; Grants NSF G-25193; NSF GP-2629)

The variation of magnetic activity at high latitude at conjugate points is discussed, and a brief outline of relevant literature research on the subject is presented. Power spectra data of such activity at Pt. Barrow and at Shepherd Bay are graphically depicted, and are discussed. Disturbances occurring on the dayside and nightside are considered. Hydromagnetic wave and particle flux propagation mechanisms for explaining these disturbances are discussed.
L.S.

N66-33197*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ELECTRON DENSITIES AND SCALE HEIGHTS IN THE TOPSIDE IONOSPHERE: ALOUETTE I OBSERVATIONS OVER THE AMERICAN CONTINENTS. VOLUME I: NOVEMBER 1962–JANUARY 1963
Kwok-Long Chan, Lawrence Colin, and John O. Thomas Washington, NASA, 1966 508 p refs
(NASA-SP-3027) CFSTI: HC $5.50/MF $2.50 CSCL 04A

Topside ionosphere plasma scale heights and electron densities were computed from Alouette I topside sounder ionograms. A tabular summary of ionograms analyzed is given, and an index to tabulations presented. The universal time, local time, geographic latitude, geographic longitude, and magnetic dip angle for the first and last ionograms of each Alouette I pass are indexed, and the number of ionograms in each pass is also indicated. Figures depict pass number, date, and period of data analyzed in universal time, and in local time.
R.L.I.

N66-33240# Houston Univ., Tex. Electrical Engineering Dept.
STATISTICAL DESCRIPTION OF OCEAN SURFACE
H. S. Hayre [1965] 6 p refs
(Contract Nonr-4492(02))
(AD-633602) CFSTI: HC $1.00/MF $0.50

Oceanographers have characterized the random ocean surface by its frequency spectrum, which, at best, includes both the crosswind and downwind spectra. Others working in the field of radar or underwater acoustic scatter fields have established that the probability density function of the ocean surface heights is normal. It is believed that crosscorrelation between the fast varying and slowly varying components of the sea surface in both downwind and crosswind directions or a generalized covariance function are essential in order to understand the surface reflection characteristics. A literature search shows that this area of surface definition has not been explored although numerous attempts have been made to utilize the wave spectra, sea state, and/or wind velocity to empirically relate the return signal and the return.
Author (TAB)

N66-33289# Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
TWO-DIMENSIONAL ANALYSIS OF STRESS AND STRAIN IN SOILS. REPORT NO. 2: DEVELOPMENT OF PLASTIC ZONE BENEATH A FOOTING
Robert V. Whitman and Kaare Hoeeg Dec. 1965 49 p refs *Its* Contract Rept.-3-129
(Contract DA-22-079-ENG-427) (R65-61; AD-633740) Available from Army Engr. Waterways Expt. Station, Vicksburg, Miss.: HC $0.75; CFSTI: MF $0.75

An earlier report by Whitman analyzed the need for more adequate computational procedures than presently in use for problems in soil engineering. Whitman studied the potential usefulness of plasticity theory for this purpose and suggested the application of a lumped parameter model developed by Ang and Harper (1964) to calculate the distribution of stresses and strains within soild masses. This report presents a continuation of Whitman's studies and had as its main objectives: (1) to examine the performance and accuracy of the computational model, and (2) then proceed to analyze the development of the plastic zone beneath a strip footing resting

on an elastic perfectly plastic foundation material. The report concludes that the use of the simple discrete model is a promising approach, and similar techniques will be applied during a continuation of this research program. The computed results for the flexible and rigid strip footings analyzed in this study showed the gradual development of the plastic zone, the corresponding displacement fields, and the accumulation of footing settlements as the full shearing resistance of the foundation material was mobilized. The load-settlement curves approached asymptotically the bearing capacity which was in agreement with the ultimate load predicted by plasticity theory.
Author (TAB)

N66-33290# New York Univ., N. Y. Courant Inst. of Mathematical Sciences.
ASYMPTOTIC BEHAVIOR OF PLANETARY-SCALE MOTIONS OF THE ATMOSPHERE
George K. Morikawa Apr. 1966 41 p refs
(Contract Nonr-285(55))
(IMM-348; AD-633737) CFSTI: HC $2.00/MF $0.50

Asymptotic equations describing slowly varying planetary-scale motions of the atmosphere over the rotating earth are derived and compared to the geostrophic equations of motion in the tangent plane approximation. Since the same approximation procedure is used in both the spherical and plane geometry, a direct term by term comparison is possible. The plane approximation yields familiar prognostic equations (initial value problem); but in the more constrained spherical geometry, a more restricted forcing type problem results if the zonal motion is time-dependent. That is, with a given slowly varying or steady zonal motion, is associated a class of long-wave tesseral motions, i.e., coupled low-wave-number and meridional motions.
Author (TAB)

N66-33292# Kondner Research, Deerfield, Ill.
A RHEOLOGIC INVESTIGATION OF THE DYNAMIC RESPONSE SPECTRA OF COHESIVE SOILS Summary Report
R. L. Kondner Nov. 1965 105 p refs
(Contract DA-22-079-ENG-434)
(Rept.-3-148; AD-633802) Available from Army Engr. Waterways Expt. Station, Vicksburg, Miss.: HC $1.00; CFSTI: MF $0.75

Theoretical and experimental studies of the stress-strain-time-strength response of cohesive soils in unconfined compression under blast pulse, creep, and vibratory loadings covering wide ranges of variables are presented in terms of unified viscoelastic response spectra through the use of a nondimensional parameter denoted as the soil compliance (a reciprocal form of strain dependent, nondimensional soil modulus). Nonlinearity of the response is handled through the use of a hyperbolic stress-strain relation. The time spectrum covered by such response spectra varies from less than 1 millisecond to more than 1×10,000 minutes—a range of over nine decades of time corresponding to loading conditions involving the very small times associated with characteristic time parameters of nuclear blast loading to the long time creep type of loadings associated with the static weight of protective construction systems. Moisture contents range from approximately 18 percent to 41 percent and include the range of soil consistencies and strengths (0.3 kg per sq cm to more than 15 kg per sq cm) generally encountered in field applications. Applied stress levels vary from approximately 0.7 percent of the soil strength all the way to failure. Strain levels investigated range from 0.0003 percent to more than 22 percent and consideration is given to elastic and plastic strains. Various aspects of wave propagation are presented in terms of the response spectra. Use of spectra techniques for other soils and lateral constraint is illustrated. Footing displacement under blast loading is discussed using spectra response.
Author (TAB)

N66-33355# Naval Oceanographic Office, Washington, D. C.
LONG-RANGE ICE OUTLOOK EASTERN ARCTIC (1966)
May 1966 27 p
(SP-60(66); AD-633899) Available from Naval Oceanog. Office, Washington: HC $0.80; CFSTI: MF $0.50

An analysis of oceanographic and climatic data for forecasting the ice growth during the winter 1965–66 and the climatic outlook for the 1966 Arctic shipping season are included. Results of a preliminary survey of sea-ice conditions in the Labrador Sea, Davis Strait, Denmark Strait, and Baffin Bay are presented. A series of charts shows monthly prognostic sea-ice conditions from mid-May through mid-August 1966. Opening dates and harbor freezing information are included.
Author (TAB)

N66-33412*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COSMOGENIC RADIOACTIVITIES IN THE PEACE RIVER AND HARLETON CHONDRITES
J. P. Shedlovsky and Philip J. Cressy, Jr. (Carnegie Inst. of Tech.) [1964] 17 p refs Submitted for Publication
(Contract AT(30-1)-844)
(NASA-TM-X-54825) CFSTI: HC $1.00/MF $0.50 CSCL 08G

The results of measurements of cosmogenic radionuclides in the Peace River and Harleton chondrites are reported. Activity ratios of short- and long-lived nuclides are compared with ratios observed in other freshly-fallen meteorites. Long-term temporal constancy of the cosmic-ray flux is indicated and the spatial constancy of cosmic radiation throughout meteoritic orbits is supported. The eleven-year solar cycle does not appear to have had any significant effect on activities with half-lives on the order of a year or longer, such as Mn^{54} and Na^{22}. The activities are compared with thick-target bombardments which indicate that the pre-atmospheric size of Harleton was smaller than that of the Peace River, Bruderheim, and Ehole meteorites.
Author

N66-33418*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SOME CHEMICAL ASPECTS OF UPPER-ATMOSPHERE RESEARCH
Richard A. Hord and Harold B. Tolefson [1964] 14 p refs Presented at the Chem. Section, Va. Acad. of Sci., Charlottesville, 8 May 1964 Submitted for Publication
(NASA-TM-X-54833) CFSTI: HC $1.00/MF $0.50 CSCL 04A

An experimental technique for measuring winds and other upper atmospheric properties at night at altitudes greater than 90 km is described. The method utilizes a chemiluminescent gas trail whose behavior is observable at night, and complements the sodium vapor trail technique which is applicable at twilight. The sodium method is based upon resonant scattering of the D-lines. The energy for the chemiluminescent gas reaction is derived from the chemical energy stored in the upper atmosphere in the form of atomic oxygen. Experiments in which nitric oxide, ethylene, a mixture of sodium and thermite, carbon disulfide, and trimethyl aluminum were used as the chemical release agents are reported in the literature. The trimethyl aluminum was the most successful of these for duration of the glow above 100 km; but presents a safety problem. Also discussed are experiments in which winds were measured by

cloud movements; bismuth oxide and tetramethyl lead vaporizer release agents; triangulation techniques; and photography. L.S.

N66-33442*# Howard Univ., Washington, D. C. Dept. of Physics.
[INVESTIGATION OF INFRA-RED ABSORPTION AND LOW ANGLE X-RAY SCATTERING OF TEKTITES] Semi-annual Status Report, 1 Dec. 1965–30 Jun. 1966
Jul. 1966 26 p refs
(Grant NGR-09-11-006)
(NASA-CR-77049) CFSTI: HC $2.00/MF $0.50 CSCL 08G

An infrared absorption technique is being devised to determine the water content of tektite glass and involves the use of a high resolution Perkin–Elmer single beam double pass instrument. Absorption measurements to date are tabulated and the individual spectra are graphically shown. A plot of the absorption constant versus concentration of the absorbing species indicates that the water in both tektites and obsidians obeys Beer's law. Low angle X-ray scattering measurements of tektites indicate that a weak alpha-iron line found in tektite X-ray diffraction patterns is probably due to small iron spherules with a volume fraction on the order of 10^{-5} to 10^{-4}. This is about the same order of magnitude as derived from magnetic measurements. Experiments are being made with the Mossbauer technique to see if it is possible to detect metallic iron in long term high resolution analysis and to determine the nature of the iron complex in tektite glasses. Typical data on two tektites and one obsidian are shown. R.N.A.

N66-33443*# Auburn Research Foundation, Inc., Ala.
EVALUATION OF DATA OBTAINED FROM A 35 GHZ PROPAGATION EXPERIMENT Technical Report No. 7
E. R. Graf Jan. 1966 18 p ref
(Contract NAS8-11184)
(NASA-CR-76857) CFSTI: HC $1.00/MF $0.50 CSCL 04A

The determination of the effect of atmospheric conditions on the propagation of electromagnetic waves has been the object of much experimental study. This report presents the results of an analysis of data obtained during a propagation experiment. A frequency of 35 GHz was used in performing the experiment. An empirical equation relating attenuation and relative humidity was obtained and the results of the experimental data were compared with this equation. The two were found to agree quite well in the humidity range 0–50%. Above 50% humidity, droplets begin to form which produce scattering. This scattering completely disguises any simple attenuation effects as the humidity is increased. Author

N66-33522# Uppsala Univ. (Sweden). Seismological Inst.
SEISMIC WAVE PROPAGATION IN LAYERED MEDIA. PART I Scientific Report
Enders A. Robinson 15 Apr. 1966 14 p *lts* Rept.-37
(Contract AF 61(052)-702)
(AFCRL-66-435; AD-634914) CFSTI: HC $1.00/MF $0.50

A simplified treatment of seismic wave propagation in layered media is presented. An earth model is used such that the seismic rays are assumed to be normal to the interfaces, with consideration given only to compressional plane waves. Since there will be a sudden variation in the density and velocity at each layer interface, a series of wave equations are used. The wave equations are solved by the Laplace transform method, with the boundary conditions expressed in matrix form for an arbitrary boundary. C.T.C.

N66-33523# National Committee for Space Research, Haifa (Israel). Radio Observatory.
IONOSPHERIC RESEARCH USING SATELLITES Annual Summary Report
Jonathan Mass 29 Dec. 1965 53 p refs
(Contract AF 61(052)-837)
(AFCRL-66-383; AD-634910) CFSTI: HC $3.00/MF $0.50

The satellite receiving station is described. The methods used for determining the ionospheric total electron content and its horizontal gradient are discussed and results for the period Nov. 1964–June 1965 are presented. Research done on the Faraday fading rate at near transversal propagation is reported. Author (TAB)

N66-33551# Atomic Energy Commission, New York. Health and Safety Lab.
FURTHER STUDIES OF EXTERNAL ENVIRONMENTAL RADIATION
H. L. Beck, W. M. Lowder, B. G. Bennett, and W. J. Condon Mar. 1966 53 p refs
(HASL-170) CFSTI: HC $3.00/MF $0.50

Spectrometric techniques developed for measuring total and individual component gamma dose rates from naturally occurring and fallout emitters are elaborated upon and extended to new applications. The calibration of high resolution 4×4 in. NaI(Tl) detectors for such measurements is described. Field studies utilizing these techniques during 1965, including measurements of gamma dose rates at approximately 50 ground sites scattered around the United States as well as on high altitude lakes and in deep mines, are summarized and the data presented in full. These results provide useful information relevant to continuing studies of the application of field spectrometry to the rapid assessment of fallout deposition, particularly ^{137}Cs, the variations of natural gamma dose rate with time, and the contributions of soil beta activity and cosmic radiation to free air ionization near the air–ground interface. A detailed description of the argon-filled high pressure ionization chamber used for total dose rate measurements is presented. Author (NSA)

N66-33591# United Aircraft Corporate Systems Center, El Segundo, Calif. Weapons Effects and Support Systems Dept.
THEORETICAL GROUND SHOCK EFFECTS. VOLUME I: GROUND MOTION IN ELASTIC HALF-SPACES INDUCED BY AIR BLAST Final Report
Roger F. Gans and John A. Brooks Dec. 1965 132 p refs
(Contract DA-49-046-XZ-220)
(SCR-275; DASA-1676-I; AD-633618) CFSTI: HC $4.00/MF $1.00

The problem of the ground response to the air blast loading caused by a surface nuclear burst in the elastic region was treated using a ground model of elastic half space both layered and non layered. The air blast loading was approximated by a source of acoustic waves in an overlying fluid. The emphasis is directed toward the investigation of surface wave effects. The report includes discussion of the response in terms of velocities and stresses at various points in the media. The data are presented in graphical form and the necessary derivations are given. In addition the nature of the Rayleigh wave is discussed and a simple damping constant for the Rayleigh response is shown to exist naturally in the solutions.
Author (TAB)

N66-33605# Texas Univ., Austin. Electrical Engineering Research Lab.
A FINITE-DIFFERENCE STUDY OF THE EFFECT OF CURRENT AND CHARGE SOURCES ON THE ELECTRO-MAGNETIC FIELD OF THE EARTH

John E. Boehl and Francis X. Bostick, Jr. 20 May 1966 70 p refs
(Contract Nonr-375(14))
(Rept.-143; AD-633652) CFSTI: HC $3.00/MF $0.75

A finite-difference approach to the description of the electromagnetic field structure within the region bounded by the earth and some outer spherical boundary is studied. Within this medium, a current sheet and a free charge sheet are assumed to exist in a spherical geometry. The medium is assumed to be two-dimensionally inhomogeneous and to consist of a plasma gas. The earth is considered to be perfectly conducting, and the field distribution at the outer boundary is caused to assume the form of a system of spherical waves which are propagating outwardly. Author (TAB)

N66-33701*# National Aeronautics and Space Administration, Washington, D. C.
SPECTRAL ALBEDO OF NATURAL GROUNDS [SPEKTRAL'NOYE AL'BEDO YESTESTVENNYKH PODSTILAYUSHCHIKH POVERKHNOSTEY]
K. Ya. Kondrat'yev, Z. F. Mironova, and A. N. Otto Jul. 1966 26 p refs Transl. into ENGLISH from Izd. Leningr. Univ., Probl. Fiz. Atmosfery (Leningrad), Issue 3, 1965 p 24–47
(NASA-TT-F-10229) CFSTI: HC $2.00/MF $0.50 CSCL 04A

The authors give the results of recent measurements of albedo from various natural surfaces: agricultural crops, soil, snow, water, etc. The data are used for compiling tables of spectral albedo for individual days as well as the averages for several days. Curves are given showing the spectral characteristics of albedo from the various types of surfaces. The data given in this article are basically from measurements under clear weather conditions. More observations under varying conditions of illumination are needed for a better understanding of the factors involved in changes of albedo from natural underlying surfaces. Author

N66-33703*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
THE GRAVITY POTENTIAL AND FORCE FIELD OF THE EARTH THROUGH FOURTH ORDER
C. A. Wagner Washington, NASA, Aug. 1966 65 p refs
(NASA-TN-D-3317) CFSTI: HC $2.50/MF $0.75 CSCL 04A

The exterior gravity potential of the spheroidal earth which is usually presented as a series of spherical harmonic terms, is derived as a classical solution of Laplace's equation in spherical coordinates. The series is truncated at the $1/r^3$ terms, and it is shown that this truncation gives the potential for a rotating triaxial earth, having small oblateness and equatorial eccentricity, with an equipotential surface. The coefficients of the truncated series are interpreted as function of the geometric parameters of the matching triaxial earth model and its rotation. The harmonic coefficients, measured to date from gravity surveys and satellite data, show that the earth has an oblateness of 1/298.2 and an equatorial eccentricity of 1.14×10^{-5}, which corresponds to a difference of major and minor equatorial diameters for the earth of about 475 ft. The higher order harmonics are interpreted as reflecting additional small longitude and latitude-dependent surface deviations from this triaxial earth. The effect on the earth surface model (the geoid) of terms through J_{44} is calculated, but the longitude-dependent deviations themselves are left in general terms as functions of the harmonic coefficients. Certain large-scale features that appear to be discernable already are discussed. The gravity and geometric effects of the small nutations of the north pole are also discussed. The gravity effects are shown to be entirely negligible for most applications. The geometric effects might well be discernible by close long-term study of the geoid coordinate errors of stations used as references in the observation of earth satellites. Author

N66-33708# Kakioka Magnetic Observatory (Japan).
GEOMAGNETISM, MEMAMBETSU 1960
1966 130 p refs
CFSTI: HC $4.00/MF $1.00

Hourly values of geomagnetic elements are reported. Descriptions are given of the observatory site, buildings, and instruments. The tables include scale and base-line values, declination, vertical intensity, horizontal intensity, mean hourly values, geomagnetic indices, and character of principal magnetic disturbances. Reproductions of the magnetograms are given for all days. E.A.O.

N66-33720*# National Aeronautics and Space Administration, Washington, D. C.
BIBLIOGRAPHY ON GROUND-WATER POLLUTION AND WASTE WATER PURIFICATION [BIBLIOGRAFIE GROND-WATERVERONTREINIGING EN AFVALWATERZUIVERING]
G. De Vries July. 1966 57 p refs Transl. into ENGLISH from Dutch
(NASA-TT-F-10215) CFSTI: HC $2.50/MF $0.50 CSCL 08H

This bibliography is meant as an introduction to literature on the subject of ground water pollution and waste water purification. It contains: abstracts from articles and reports, a list of Dutch institutions engaged in water purification and the quality of open water and ground water in Holland, and a list of the most important periodicals on this subject. Author

N66-33765*# National Aeronautics and Space Administration, Washington, D. C.
SPACE PHOTOGRAPHY FOR THE GEOGRAPHICAL STUDY OF THE EARTH [KOSMICHESKAYA FOTOGRAFIYA DLYA GEOGRAFICHESKOGO IZUCHENIYA ZEMLI]
B. V. Vinogradov Aug. 1966 27 p refs Transl. into ENGLISH from Izv. Vsesoyuznogo Geogr. Obshchestva (USSR), v. 98, no. 2, 1966 p 101–111
(NASA-TT-F-10246) CFSTI: HC $2.00/MF $0.50 CSCL 08B

The various means of space photography are reviewed, including photographs taken from research rockets (V-2, Viking, Aerobee), spacecraft (Mercury, Vostok, Voskhod and Gemini), and artificial Earth satellites (Tiros, Nimbus). It is pointed out that the quality of the photographs is not as high as it could be because none of the space vehicles was especially designed to photograph the surface of the earth; this task was only an additional operation in the flight program. Author

N66-33772 Paris Univ. (France).
PHYSICS OF THE ATMOSPHERE. VOLUME III: PHENOMENA OF ABSORPTION AND DIFFUSION IN THE ATMOSPHERE [PHYSIQUE DE L'ATMOSPHERE. TOME III: PHENOMENES D'ABSORPTION ET DE DIFFUSIONS DANS L'ATMOSPHERE]
Etienne Vassy Paris, Gauthier–Villars, 1966 309 p refs In FRENCH
CFSTI: HC $4.25/MF $1.75

Radiation absorption, diffusion of radio waves due to turbulence, and light polarization in the atmosphere are discussed. Reported are: methods of measuring ionospheric absorption, diurnal and seasonal absorption variation with frequency and other factors, noncoherent scattering by electrons; radio diffusion due to tropospheric and ionospheric turbulence; composition of the atmosphere, and vertical distribution of ozone, molecular oxygen and aerosols; atmospheric move-

ments, and meteorological aids; absolute and relative measurements of light absorption in the visible, ultraviolet and infrared regions; solar radiation and diffusion; luminous energy, and the influence of clouds; polarization of diffused solar light; luminescence, visibility and relation between various meteorological factors; corona, glory and spectrum phenomenon; cosmic and solar emission sources of radio-frequency radiation; absorption of radio waves by oxygen, water vapor, and air; radar echo, and diffusion by water droplets. R.LI.

N66-33774# Kakioka Magnetic Observatory (Japan).
REPORT OF THE KAKIOKA MAGNETIC OBSERVATORY, GEOELECTRICITY, KANOYA, 1957–1959
1966 242 p ref
(Rept.-37) CFSTI: HC $3.75/MF $1.50

This volume contains the tabulated results of geoelectric observations made at the Kanoya Magnetic Observatory, Japan during the period from 1957 to 1959. The tables contain data on hourly values of the earth current potential gradient and mean diurnal variations of all days and for five selected calm days. Reproductions of tellurigrams are also included. R.N.A.

N66-33775# Stanford Research Inst., Menlo Park, Calif.
THE CONTAMINATION BEHAVIOR OF FALLOUT-LIKE PARTICLES EJECTED BY VOLCANO IRAZU
Carl F. Miller Apr. 1966 70 p refs
(Contract N228-62479)69928; SRI-Proj. MU-5779)
(AD-634901) CFSTI: HC $3.00/MF $0.75

Photographs of objects contaminated with particles ejected from volcano Irazu in Costa Rica are presented to indicate the nature of particle behavior in various environmental situations. The similarity between the particles ejected by the volcano and the fallout particles produced by land-surface nuclear detonations suggests that the contamination behavior of the radioactive fallout particles would be similar to that observed for the volcanic particles. The peculiarities of the particle behavior are discussed in rather general terms in the figure captions for each situation depicted. Author (TAB)

N66-33776# National Observatory of Athens (Greece).
IONOSPHERIC RESEARCH USING SATELLITES Annual Report, 1 Jan. 1965–28 Feb. 1966
Michael Anastassiadis [1966] 28 p refs
(Contract AF 61(052)-754)
(AFCRL-66-388; AD-634953) CFSTI: HC $2.00/MF $0.50

The Athens Center Ionospheric Institute recorded a large number of transmissions from active satellites S-66 and BE-C on 40 mc/s fr. following a common program established by Joint Satellite Study Group. Some results on large scale irregularities are discussed and a new method to calculate the ionospheric horizontal gradient in electron content is presented. TAB

N66-33782# Joint Publications Research Service, Washington, D. C.
SUBSURFACE CAVITATION AS A SOURCE OF NOISE IN THE OCEAN
A. V. Furduyev 9 Aug. 1966 22 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Fiz. Atm. i Okeana (Moscow), v. 2, no. 5, May 1966 p 523–533
(JPRS-36907; TT-66-33337) CFSTI: $1.00

A hypothesis of the radiation of dynamic noises of the ocean by gas vapor bubbles cavitating near the surface and by resonance stable bubbles, distributed in the water stratum, is considered. An explanation of the extremum in the frequency characteristics of the dynamic noises of the ocean between 0.1–1 kc is given and the noise spectra of surface cavitation and resonance radiation by the totality of the bubbles are considered. A condition is obtained determining the cavitation threshold in wind waves as a function of the height and period of the waves, and by using a typical example, the possibility of cavitation under the crests of wind waves having a broad spectrum of amplitudes is demonstrated. Author

N66-33811# Office of Naval Intelligence, Washington, D. C. Translation Section.
MEASUREMENT OF BOTTOM CURRENTS IN THE BLACK SEA WITH A NEUTRALLY BUOYANT ULTRASONIC BUOY [IZMERENIYE GLUBINNYKH TECHENIY V CHERNOM MORE S POMOSHCH'YU ULTRAZVUKOVOY VEKHI NEYTRAL'NOY PLAVUCHESTI]
Yu. G. Ryzhkov and I. I. Karnaushenko [1966] 5 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 141, no. 1, 1961 p 74–76
(ONI-TRANS-2091; AD-633829) CFSTI: HC $1.10/MF $0.50

The utility of using a neutrally buoyant ultrasonic buoy for measuring bottom currents was investigated in the central halistatic zones of the Black Sea. The buoy was equipped with a surfacing mechanism and a depth perceptive channel which enabled continuous immersion depth registration; the ultrasonic pulse transmission frequency depended upon immersion depth. The following data were obtained for an average depth of 750 m: a horizontal velocity of two cm/s and a flow direction of 332°. It is noted that these data are in good agreement with those obtained by other methods of measurement. D.T.

N66-33829# New York Univ., N. Y. Research Div.
ON THE GROWTH OF THE SPECTRUM OF A WIND GENERATED SEA ACCORDING TO A MODIFIED MILES-PHILLIPS MECHANISM
Tokujiro Inoue Apr. 1966 71 p refs
(Contract N62306-1589)
(TR-66-6; AD-633612) CFSTI: HC $3.00/MF $0.75

A linear differential equation for the change of spectral density can be expressed by $d/dt\ S(\omega;u,x,y,t) = A(\omega;u(t,x,y)) + B(\omega;u(t,x,y))\ S(\omega;u,x,y,t)$ where $S(\omega;u,x,y,t)$ is the spectrum, and the terms $A(\omega;u(t,x,y))$ and $B(\omega;u(t,x,y))$, can be considered to be due to the Phillips type of resonance and the Miles surface instability growth theory, respectively. To determine these functions, the spectra computed from wave records obtained by the British weather ships, 'weather reporter' and 'weather explorer' were used. Also, to make up for the lack of a full range of those data, results obtained in the field study of Snyder and Cox were used. The spectral growth equation was then extended by an appropriate assumption for energy dissipation. The derived spectral growth agrees with the growth of waves obtained by Sverdrup and Munk in the wave height sense, and the spectra grow in roughly the way postulated by Neumann. The results of this study show that about 30 hours are required to reach 90% of the fully developed significant wave height for a 40 knot wind measured at 19.5 M. Also, about 600 nautical miles are needed for 90% full development for a 40 knot wind velocity at 19.5 m. The family of partially developed sea spectra is shown for wind velocities from 20 knots to 45 knots in 5-knot increments for both the duration limited and fetch limited conditions. Author (TAB)

N66-33963# Laboratoires du Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
DIFFUSION OF ATMOSPHERIC EFFLUENTS IN THE VICINITY OF MOL [DIFFUSION DES REJETS ATMOSPHERIQUES DANS A REGION DE MOL]

H. Bultynck, X. De Maere, J. Van Der Parren, and L. Malet Dec. 1965 78 p
(BLG-365, Vol. 2)

Graphs for the calculation of the diffusion of atmospheric effluents are presented. NSA

N66-34003# Naval Research Lab., Washington, D. C.
THE EXTENT OF RADIOACTIVE EQUILIBRIUM BETWEEN RADON AND ITS SHORT-LIVED DAUGHTER PRODUCTS IN THE ATMOSPHERE Interim Report
L. B. Lockhart, Jr. and R. L. Patterson, Jr. 5 Apr. 1965 19 p refs
(NRL-6374) CFSTI: HC $1.00/MF $0.50

A set of experimental conditions was derived that optimizes the accuracy with which the radon content of the atmosphere and its apparent residence time there can be determined from measurement of the filterable gross β activity during two separate 10-min periods following the end of a 20-min collection period. The 20-min collection is made on a filter of essentially 100% retentivity (glass fiber filter) and counted for β activity through a 10-mil (70 mg/cm^2) aluminum absorber on equipment of known efficiency for the β particles emitted by RaB and RaC. The ratio of measured counts during the 61-through-71-min decay period to that during the 1-through-11-min period is used to obtain the atom ratio of RaC to RaB(ρ) in the air sampled, the apparent age (τ) of the conglomerate of radon and its daughters, and the total counts to be expected from any given radon concentration in the air. Extensive examples of atmospheric measurements are given which suggest that under most conditions in the free atmosphere radon is essentially at secular equilibrium with its daughter products. Other collections made following addition of radon to a restricted volume showed the expected increase in ρ with time, which confirmed the basic validity of the procedure. Author (NSA)

N66-34044*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
METEORITIC, SOLAR, AND TERRESTRIAL RARE-EARTH DISTRIBUTION
Larry A. Haskin, Fred A. Frey (Wisconsin Univ.), Roman A. Schmitt, and Richard H. Smith 15 Dec. 1965 270 p refs Submitted for Publication
(Contracts NASw-843; NR-083-180)
(NASA-CR-77139; GA-6800) CFSTI: HC $6.00/MF $1.50 CSCL 08D

Results of a study to determine the rare earth element distributions in meteoritic, solar, and terrestrial matter are presented. The elements defined for this review are the lanthanides (Z=57-71) and Y (Z=39). The meteoritic matter considered includes chondrites, Ca-rich achondrites (eucrites), mesosiderites, Ca-rich achondrites (nakhlites), Ca-poor achondrites, and pallasites and irons. Abundances relative to terrestrial matter include igneous and metamorphic rocks, minerals, sedimentary rocks, and phosphatic materials. C.T.C.

N66-34046# International Business Machines Corp., Cambridge, Mass. Space Systems Dept.
GEOID REPRESENTATION FROM SATELLITE-DETERMINED COEFFICIENTS Final Technical Report, 7 Jun. 1965–7 Mar. 1966
A. Richard Le Schack et al 7 Mar. 1966 124 p ref
(Contract DA-44-009-AMC-1146(X))
(AD-634541) CFSTI: HC $4.00/MF $0.75

This report describes the mathematical formulations and programs developed to provide a spatial representation of a geopotential surface, based on a set of geopotential harmonic coefficients determined by an investigator from a study of satellite motion. The component parts of the problem are analyzed and discussed in detail, and the mathematical techniques for accomplishing the various objectives are presented. These techniques have been verified by hand computations and by computer programs, and have been implemented in the form of two Fortran IV programs for the IBM 7094 computer. Complete instructions for using the programs, as well as program documentation, are included. Author (TAB)

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N66-32698*# Eon Corp., Brooklyn, N. Y.
STUDY AND DEVELOPMENT OF THE STERILIZABLE GEIGER-MULLER TUBE Final Report
G. R. Weinberg Apr. 1966 44 p Prepared for JPL
(Contracts NAS7-100; JPL-951240)
(NASA-CR-76644) CFSTI: HC $2.00/MF $0.50 CSCL 18D

During the development of the sterilizable Geiger-Muller tubes, it was noticed that a number of the thin mica end window tubes exhibited a downward change in starting voltage. This occurred most often during the dry heat sterilization cycles. The drop in starting voltage was believed attributable to a slow chemical reaction between the chlorine content of the filling gas mixture and the base material of the cathode. It was further believed that by cladding the cathode surfaces with a protective coating of resistant metal this difficulty could be eliminated. A thorough investigation of plating and processing techniques was made in order to obtain clad cathode surfaces which were both mechanically and microscopically perfect and which would provide protection of the cathode base material. Author

N66-32703# Library of Congress, Washington, D. C. Aerospace Technology Div.
CINEMATOGRAPHY IN SOVIET SPACE TECHNOLOGY
In its Foreign Sci. Bull., Vol. 2, No. 6 Jun. 1966 p 50-53 ref (See N66-32699 19-34)

According to a motion-picture cameraman, technical motion-picture photography finds wide application for research work in conjunction with spacecraft and launch-vehicle designers at the space systems design and assembly plant and at the assembly shop at Baykonur Cosmodrome. Potapov has also made several popular films about the cosmonauts and their spaceflights for viewing by the general public. From 1959 to 1965, he kept notes on his work, meetings, and experiences, some of which have just been published. The following information has been derived from his descriptions and includes some new insights into Soviet testing and safety procedures. Author

N66-32816# California Univ., Berkeley. Lawrence Radiation Lab.
THREE TYPES OF 4π NEUTRON SPECTROMETERS

Roger Wallace 18 Oct. 1965 15 p refs Presented at the 1st Symp. of Accelerator Radiation Dosimetry and Experience, Upton, N. Y.
(Contract W-7405-ENG-48)
(UCRL-16311; CONF-651109-8) CFSTI: HC $1.00/MF $0.50

Emulsion, liquid scintillator, and ^3He types of 4π neutron spectrometers are described. NSA

N66-32848# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

DEVELOPMENT AND EVALUATION OF A LARGE DETECTOR MULTIDIMENSIONAL GAMMA RAY SPECTROMETER

N. A. Wogman, D. E. Robertson, and R. W. Perkins Apr. 1966 3 p ref Presented at the Am. Nucl. Soc. Meeting, Denver
(Contract AT(45-1)-1830)
(BNWL-SA-519; CONF-660606-2) CFSTI: HC $1.00/MF $0.50

A multidimensional gamma spectrometer was fabricated using two 11-inch diameter by 6-inch thick NaI(Tl) crystals which are shielded from their phototubes with 4-inch thick pure NaI light pipes. Each NaI(Tl) crystal is surrounded by 36-inch diameter by 18-inch thick plastic phosphor which is viewed by six 5-inch phototubes and functions as an anticoincidence shield. The spectrometer is coupled to a 4096 channel multiparameter analyzer and utilizes the gamma ray decay characteristics of each radionuclide for its identification and measurement. The performance of this system is described. NSA

N66-32849# California Univ., Berkeley. Lawrence Radiation Lab.

SENSITIVITY, RESOLUTION, AND LINEARITY OF THE SCINTILLATION CAMERA

Hal O. Anger Feb. 1966 31 p refs Presented at the Inst. of Elec. and Electron. Engr., Scintillation and Semicond. Counter Symp., Washington, D. C., 2–4 Mar. 1966
(Contract W-7405-ENG-48)
(UCRL-16724; CONF-660304-6) CFSTI: HC $2.00/MF $0.50

In the scintillation camera described here, an array of 19 multiplier phototubes view a single, large, thin, sodium iodide crystal. From the relative amount of light seen by each phototube when a scintillation is produced, the position is determined in two dimensions and it is displayed as a point flash of light on an osciloscope. Pictures are obtained by taking a time exposure of the oscilloscope screen. Pinhole or parallel multichannel collimation is used with γ-ray emitters, and coincidence techniques are used with positron emitters. Author (NSA)

N66-32866# United Kingdom Atomic Energy Authority, Windscale (England). Technical Dept.

AUTOMATIC MEASUREMENT OF FREE ACIDITY IN PROCESS SOLUTIONS BY COULOMETRIC TITRATION

D. T. Wooley, J. N. Money, and C. R. Mc Gowan 1966 18 p refs
(PG-692(W)) HMSO: 4s

A titrimeter was developed for the determination of free nitric acid in aqueous and organic plutonium purification process solutions. It was installed in the plant but was not connected in-line; samples were presented to it by hand but all other actions in the analytical sequence were carried out to an automatic program. The titrant was generated by external electrolysis and the end-point was detected by photometry. Author (NSA)

N66-32867# Sandia Corp., Albuquerque, N. Mex.

CLEANLINESS METER AND ITS APPLICATION TO SOLVENT CLEANING

R. C. Marsh and F. W. Oswalt Mar. 1966 26 p ref Presented at the AACC 5th Ann. Tech. Meeting and Exhibit, Houston, Tex.
(Contract AT(29-1)-789)
(SC-R-66-865; SC-DC-66-1414; CONF-660316-1) CFSTI: HC $2.00/MF $0.50

The development and application of a new instrument which will measure the soluble residue content of volatile cleaning solvents is described. The instrument, called the Solvent Purity Meter, is capable of giving an instantaneous and continuous read-out of residues as low as 1 ppM and may be used either for batch sampling or as an on-line continuous monitor for recirculating cleaning systems. Typical laboratory studies using the meter, as well as results from in-process cleanliness testing applications on component production lines, are discussed. Evaluations of the instrument, to date, showed it to be a useful production line monitor for testing the purity of cleaning solvents, as an indirect measure of component cleanliness, and for pointing out errors or problem areas when troubleshooting component cleaning problems. Author (NSA)

N66-32869# Princeton-Pennsylvania Accelerator, Princeton, N. J.

WIRE SPARK CHAMBER ELECTRONIC SYSTEM

T. Droege and W. Fullin 10 Feb. 1966 17 p refs
(Contract AT(30-1)-2137)
(PPAD-5830) CFSTI: HC $1.00/MF $0.50

A set of wire spark chambers using magnetostrictive delay lines as the readout device was earlier successfully used in a high energy physics experiment. The electron system consists of a sequencer which performs the timing and control functions, one dual gate and two four digit scalers for each delay line, a clock, and assorted pulse fan-outs and power supplies. The electronic system used with this experiment is described. NSA

N66-33014*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

AN ERROR DETECTION AND CORRECTION APPROACH TO THE TIME DECODING PROBLEM

A. M. Demmerle, T. J. Karras, and P. J. Mc Coney Washington, NASA, Aug. 1966 21 p
(NASA-TN-D-3494) CFSTI: HC $1.00/MF $0.50 CSCL 09F

The error detection and correction capabilities available in redundant information have been used in a system which copes with a large variety of erroneous time code readings from analog magnetic tapes. The system both decodes and evaluates the redundant information contained in the incoming serial decimal time code and binary coded decimal time code and compares this decoded and evaluated time reading with previously received and evaluated time information. The output time word resulting from these comparisons and evaluations also contains flags which can be analyzed to indicate the degree of confidence which the user can place in its accuracy. The decoder also contains self-checking circuits to reduce the probability that a malfunctioning decoder component will cause an undetected incorrect time reading. Author

N66-33026# United Kingdom Atomic Energy Authority, Harwell (England). Chemical Engineering Div.

AN OUTLINE OF THE CHARACTERISTICS AND CONSTRUCTION OF THE DATA ACQUISITION SYSTEM USED ON THE HARWELL HIGH PRESSURE STEAM/WATER LOOP

D. Benn Feb. 1966 23 p refs
(AERE-R-5128) HMSO: 3s

The system described is intended to record millivolt signals from thermocouples and pressure transducers in either digital or analog form with minimal interference from spurious signals and with high accuracy. The digital system is capable of recording with a sensitivity of 10 micro-volts, sampling the 50 possible inputs at one per second giving a typewritten output. The performance is somewhat better than could be expected from the makers specifications and is subject to use in a unipolar mode. In analog form, the inputs can be recorded on a high sensitivity, low noise, six channel pen recorder. Author

N66-33029# United Kingdom Atomic Energy Authority, Risley (England). Reactor Group.

A REVIEW OF ULTRASONIC PROBE TECHNOLOGY WITHIN THE U.K.A.E.A.

A. Reid 1966 31 p refs
(TRG-1116(S))

In this report it is assumed that the probe is to be used in the pulse echo mode. Therefore the basic requirements are good sensitivity and good resolution and also a suitably shaped ultrasound beam. The design of a probe is discussed by considering: (1) The transducer and various piezoelectric crystals and ferroelectric ceramics. (2) Probe application—the requirements for pulse echo testing are discussed. (3) Backing medium—the reason for using a $\lambda/2$ crystal and the properties of the backing medium are discussed. (4) Impedance matching of the crystal and the flaw detector—this enables maximum energy transfer between flaw detector and crystal and vice versa. (5) Loop gain—a measure of the performance of a crystal in transmitting and receiving ultrasound. The construction of an ultrasonic immersion probe is described. Details are sufficient for anyone interested in making their own probes. Pictorial presentation of ultrasound beams is described and results are shown for one particular method—beam scanning using a facsimile recorder to display the results. Author

N66-33032# United Kingdom Atomic Energy Authority, Capenhurst (England). Production Group.

A SORPTION ANALYSER FOR THE DETERMINATION OF TRACE COMPONENTS IN GAS STREAMS

P. J. Davies and A. G. Hamlin 1966 25 p ref
(PG-700(CA)) HMSO: 2s 6d

The analyzer is derived from a gas chromatograph, and uses the same gas stream as sample and carrier gas. The trace component is allowed to adsorb on to the column over a period of time and then desorbed as a sharp peak by heating the column rapidly. The sensitivity is governed only by the mass flow of gas during the adsorption period. The analyzer was developed specifically to determine traces of ammonia in hydrogen in a closed system and is capable of monitoring 0-250 v.p.m. or more in a 15 minute cycle. It can, however, be applied to any system where a suitable adsorbate/adsorbent combination exists, and is particularly applicable to equilibrium systems or to those containing dangerous or valuable constituents since there need be no overall change or loss. It can determine several materials simultaneously if their adsorptive properties differ sufficiently. Author

N66-33033# United Kingdom Atomic Energy Authority, Harwell (England). Electronics and Applied Physics Div.

SOME ADVANTAGES AND DISADVANTAGES OF A UNIT SYSTEM OF ELECTRONICS

H. Bisby Mar. 1966 12 p refs
(AERE-M-1729) HMSO: 1s 9d

The dilemma of an electronics division, arising from reasonable user requirements, is highlighted and the reasons are given why rationalization through a unit system of electronics, is necessary. The advantages and disadvantages of this solution are set out. Author

N66-33127# European Atomic Energy Community, Brussels (Belgium).

RESOLUTION, EFFICIENCY AND BACKGROUND EFFECTS IN SEMICONDUCTOR SANDWICH FAST NEUTRON SPECTROMETERS

R. A. Rydin Jun. 1966 48 p refs
(EUR-2994.e) CFSTI: HC $2.00/MF $0.50

Four separate areas related to semiconductor sandwich spectrometer response were analyzed, making extensive use of digital computer calculations. Response functions were calculated for various layer thicknesses of Li^6F and gold at a number of different energies. Results compare favorably with existing experimental data. The relative detection efficiency, for detection of the reaction products in coincidence, was calculated for both He^3 and Li^6 spectrometers as a function of detector orientation angle. The effect is found to be significant, especially for the He^3 spectrometer. Spectrum unfolding techniques are essentially not necessary for Li^6 spectrometers above 0.5 MeV, but it was found that care must be taken to correctly interpret the absolute detection efficiency of the detector. The true coincidence background response, due to reactions occurring in the silicon of the diodes, was calculated for the case of an incident Pu-α-Be neutron spectrum. The background was found to be due primarily to the ground state (n,p) and (n,α) reactions. The results are in good agreement with available experimental data. Author

N66-33135# International Atomic Energy Agency, Vienna (Austria).

NEUTRON DETECTORS

May 1966 411 p refs *Its* Bibliog. Ser. No. 18
CFSTI: HC $7.10/MF $2.25

A bibliography on neutron detectors is presented, which covers the period 1947–1965 and contains 1989 references. Source material appears in six categories: neutron detectors, neutron spectrometry, neutron source calibration, books and survey articles, and neutron dosimetry. Author and subject indexes accompany the abstracted material. S.P.

N66-33142# National Bureau of Standards, Washington, D. C.

SPOT DIAGRAMS FOR THE PREDICTION OF LENS PERFORMANCE FROM DESIGN DATA

Orestes N. Stavroudis and Loyd E. Sutton 7 Sep. 1965 104 p refs
(NBS-Monograph-93) GPO: $0.75

The methods used to predict the performance of lenses from an analysis of their designs, based on the use of spot diagrams, are discussed. Techniques used to calculate, produce, and interpret spot diagrams, which represent the distribution of the light intensity in the image of a luminous point object and are therefore geometrical optics analogs of star images, are outlined in detail. Interpretation of spot diagrams is discussed, including direct visual inspection to obtain subjective comparisons and interpretation of supple-

mentary tables and graphs obtained from the numerical data generated by spot diagrams. Results indicated that these diagrams are useful in predicting lens performance, but that improvement in accuracy and reliability could be made in two areas: (1) the information content should be broadened to include physical data such as phase and signal strength as well as ray coordinates from which diffraction calculations could be made and (2) the Hopkins formula may provide a more reliable means of predicting off-axis resolving power. L.E.W.

N66-33153# British Broadcasting Corp., Kingswood (England). Engineering Div.

USE OF A LINEAR MATRIX TO MODIFY THE COLOUR ANALYSIS CHARACTERISTICS OF A COLOUR CAMERA

A. H. Jones [1965] 16 p refs

(T-157) CFSTI: HC $1.00/MF $0.50

A substantial degree of improvement in the colour fidelity of a colour camera can be effected by the use of a linear matrix inserted in the signal chain at some convenient point before gamma correction. Calculations have indicated that the colour fidelity obtained from fairly broad analysis curves when such a matrix is used is superior to that which would have been obtained using the narrow analysis curves specified in TV/126 and TV/148. Moreover, the cost in terms of signal-to-noise ratio or sensitivity is very small, and is less than would result from the use of the narrow curves specified in TV/126 and TV/148. Author

N66-33156# United Kingdom Atomic Energy Authority, Harwell (England).

A SIMPLIFIED TYPE OF SPECTROMETER OF HIGH APERTURE RATIO

R. F. Vasil'ev, T. N. Zhuchkova, and S. M. Petukhov Jan. 1966 8 p refs Transl. into ENGLISH from Optiko-Mekh. Prom. (Leningrad)

(AERE-TRANS-1050)

A spectrometer of high aperture ratio, designed for investigating a faint chemiluminescence recorded in many chemical reactions, is described. The instrument can also be used in cases when maximum light-gathering power is essential but high resolving power is not required. The great sensitivity of the apparatus is due to the long slits, the large aperture, and to the choice and cooling of the photomultipliers. The comparatively good resolving power is due to the use of curved slits. The optical system of the monochromator is symmetrical; the focal length of the spherical mirror is 300 mm, and its diameter is 320mm. Dispersion is effected by a plane replica of a diffraction grating 150mm×140mm, having 600 lines to the millimeter. The effective spectral range with the photomultiplier is λ=300–620mμ. Image distortion in the optical system; astigmatism of the mirror; and spherical abberation in the system are discussed. A labelled diagram of the spectrometer optical system is depicted. L.S.

N66-33167*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

INSTRUMENTATION FOR INVESTIGATING THE PHYSICAL PROPERTIES OF THE LUNAR SURFACE

Alfred G. Beswick Pittsburgh, Pa., ISA [1964] 21 p refs Presented at the 19th Ann. ISA Conf. and Exhibit, N. Y., 12–15 Oct. 1964

(NASA-TM-X-54872) CFSTI: HC $1.00/MF $0.50 CSCL 03A

One of the problems confronting the current effort to explore the moon is the physical condition of the lunar surface, particularly with regard to its bearing strength with respect to spacecraft landings. Researchers have found that a good idea as to the hardness, bearing strength, and penetrability of the lunar surface can be gained from analysis of the deceleration time history resulting from the impact of deceleration measuring instruments, i.e., impact accelerometers. The accelerometers are embodied in a structure called a pentrometer which also houses a radio telemeter. The penetrometer thus has the capability of transmitting the impact information to a remote receiver. The instrumentation concepts and details of two types of penetrometers are described. Typical applications of how such instrumentation might be employed to investigate lunar or planetary surface conditions with various spacecraft are presented. Author

N66-33228# Naval Radiological Defense Lab., San Francisco, Calif.

COMPARISON OF CESIUM IODIDE AND SODIUM IODIDE FOR UNDERWATER RADIATION DETECTION SYSTEMS

Edward J. Wesley and Richard A. Nyberg 21 Apr. 1966 20 p refs

(USNRDL-TR-1012; AD-633752) CFSTI: HC $1.00/MF $0.50

Comparison is made between NaI and CsI scintillation detectors for application to an ultrasensitive underwater detection system. A series of measurements are reported on the response of each crystal to the gamma rays from 40K distributed in water, the attenuation of the integrated count rate by aluminum and steel absorbers surrounding the detector and the background count rate from contaminants on the crystal-phototube assembly and pressure housings. It is assumed in the discussion that NaI crystals will always have to be protected from thermal and mechanical shock by a pressure vessel and that CsI, which is much less susceptible to these types of shock, can be exposed to the hydrostatic pressures in the ocean without damage. The minimum detectable change in 40K concentration is calculated, based on the measured signal and background counts for a CsI crystal and several NaI assemblies with steel and aluminum pressure vessels. It is concluded that, for deep submergence work with detectors of equivalent size, a CsI system is the most sensitive and when compared in terms of a specific detection capability, the least expensive. To complete the evaluation, the assumption that CsI can be operated to all depths without a pressure vessel must be confirmed. Author (TAB)

N66-33399*# Control Data Corp., Minneapolis, Minn.

DESIGN OF AN AUTOMATED STELLAR PROPER MOTION MEASURING SYSTEM, 1 JULY 1965–30 JUNE 1966

James S. Newcomb, George E. Zenk, and Anton E. La Bonte [1966] 126 p refs Prepared for Minnesota Univ.

(Contract NSR-24-005-062)

(NASA-CR-77063) CFSTI: HC $4.00/MF $1.00 CSCL 03A

This report presents the design for a scanning system for measuring the stellar proper motions recorded on pairs of star plates of the same regions of the sky taken a decade apart for the National Geographic-Mount Palomar Observatory Sky Survey. The laser beam-rotating prism scanner is described and its resolving power in detecting the faintest stars now detectable by blink machine methods is evaluated. The functions and properties of the electronic signal processing and automatic gain control systems are presented. A computational program by which stellar proper motions may be identified and documented is set forth. Author

N66-33406# National Bureau of Standards, Washington, D. C.

STANDARD NUCLEAR INSTRUMENT MODULES

Louis Costrell Washington, AEC, Jan. 1966 21 p ref

(TID-20893, Rev.) GPO: $0.20

Various requirements and problems regarding standard solid state nuclear instrument modules are presented. In addition to power, shielding, and other specification requirements for the modules, photographs of the instruments and comments on them are made. Specification drawings for the 5-1/4, and 8-3/4 inch standard module systems are listed by lot number and are available upon request. Some degree of standardization of the bins and power supplies was needed so that the modules could be mated to the bins, and the bins could be mated to the power supplies. L.S.

N66-33459*# Westinghouse Electric Corp., Pittsburgh, Pa.
FLIGHT TYPE OXYGEN PARTIAL PRESSURE SENSOR
S. A. Sternbergh and W. M. Hickam Washington, NASA, Aug. 1966 50 p
(Contract NAS1-4340)
(NASA-CR-534) CFSTI: HC $2.00/MF $0.50 CSCL 06B

A high temperature galvanic cell made of calcium stabilized zirconium oxide electrolyte with porous metallic electrodes was investigated as a means of continuously monitoring oxygen pressure in space capsules. These cells generate a voltage between their electrodes which is proportional to the logarithms of the ratio of the partial pressures of oxygen at the two electrodes. The current carrier through the solid electrolyte is ionic oxygen ($O^{=}$). A miniature, flight type, oxygen sensor was developed which utilizes the high temperature galvanic cell and in which complete control of both the reference and test gases is possible. A description of the oxygen pressure is given and test results of a prototype sensor are presented, along with life test data on standard cells operating under various conditions. Author

N66-33471# Ohio State Univ. Research Foundation, Columbus.
EXPECTED INSTRUMENT ACCURACY OF MICROWAVE DISTANCERS Scientific Report No. 18
Simo H. Laurila Dec. 1965 103 p refs /ts Rept.-64
(Contract AF 19(628)-2771)
(AFCRL-66-51; AD-634240) CFSTI: HC $4.00/MF $0.75

Humidity effect in microwave distancers was evaluated and found to cause phase shifting in the cyclic error variation. Cyclic error variation was found to be present in MRA-1, MRA-2 and MRA-3 tellurometers reaching values up to ±20 cm. The repetition of measurements at different weather conditions and by extending the line 15 m with 1 m intervals between measurements proved to improve the results essentially in MRA-1 and MRA-2 operations. The extension of the line 10 m in MRA-3 operations and the use of interchangeable Master/Remote functioning proved to be necessary to obtain the ultimate accuracy. The resolution capability of the MRA-1 and MRA-2 tellurometers is about ±2.3 cm, while the allover standard error for one observation is about ±7.5 cm. The resolution capability of MRA-3 tellurometer is about ±1.3 cm and the allover standard error for one observation is about ±1.5 cm. The standard error for one observation in Electrotape DM-20 seems to be about ±0.8 cm. The use of microwave absorbents or reflection plates has been found to reduce the reflection errors from solid or moving objects. Author (TAB)

N66-33487*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
USE OF A FLUIDIC OSCILLATOR AS A HUMIDITY SENSOR FOR A HYDROGEN-STEAM MIXTURE
Paul R. Prokopius Washington, NASA, Aug. 1966 14 p refs
(NASA-TM-X-1269) CFSTI: HC $1.00/MF $0.50 CSCL 07D

A continuous-reading humidity sensor was developed for transient studies of a hydrogen–oxygen fuel-cell system in which the water produced is removed from the cells in vapor form by a recirculating hydrogen stream. The basis of the sensor is a fluidic oscillator that has an oscillation frequency sensitive to molecular weight and, hence, humidity of the hydrogen–steam mixture. A test program was conducted on the instrument to define its steady-state and transient performance. The test program also resulted in a determination of the failure modes and accuracy limitations of the instrument. An analog computer program that serves as a data analyzer and results in the conversion of the humidity sensor from an indirect- to a direct-reading instrument was also developed. The steady-state performance tests resulted in calibration curves that relate humidity to oscillation frequency of the sensor at various pressure and temperature conditions of the hydrogen–steam mixture. The calibration accuracy was approximately ±2 percent. Analysis of frequency-response data indicated that the frequency response of the sensor was flat, at least to the 3-cycle-per-second limit of the test apparatus. Author

N66-33539*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
AN ORBITING DENSITY MEASURING INSTRUMENT
D. A. Wallace, K. W. Rogers, J. B. Wainwright, and R. L. Chuan 26 May 1966 57 p refs
(NASA-TM-X-53468) CFSTI: HC $2.50/MF $0.50 CSCL 14B

A design study has been conducted for a direct air density measuring device that can be carried onboard an orbiting spacecraft in the altitude range from 140 to 280 km. The resulting design calls for a free molecular cryopumped gas collector of nearly unity capture coefficient, using an orifice collector and a cooled piezoelectric crystal acting as a microbalance. Refrigeration is by heat sinks pre-conditioned before launch. Measurement is through beat-frequency (between cryopumping crystal and a variable oscillator) converted to dc voltage, thence to telemetry. Author

N66-33544*# National Aeronautics and Space Administration, Washington, D. C.
COMPUTER WORK AIDS PHOTOGRAPHY FROM SURVEYOR I
4 Aug. 1966 9 p
(NASA News Release 66-206) Available from the Scientific and Technical Information Division CSCL 14E

Television pictures of the moon taken by Surveyor I were enhanced by a computer process which brought out details to one-fiftieth of an inch in height, according to a press release from NASA. The flow pattern of dirt clouds in one enhancement indicated that they were scattered by the landing impact of one of Surveyor's footpads. The sharper prints are produced by a computerized system which corrects distortion and improves resolution in the original photographs. This is accomplished by the recording of the vidicon signals from the spacecraft on magnetic tape, which is fed into a computer where the image is reconstituted according to the points and lines of the vidicon system. Noise in transmission is eliminated, and after electronic correction, the data are transferred to another magnetic tape, which is run through a film reproducer for the corrected photograph. M.W.R.

N66-33578# Nuclear-Chicago Corp., Des Plaines, Ill.
DEVELOPMENT OF AN AUTOMATIC REMOTE RADIATION MONITORING (ARRM) SYSTEM Final Engineering Report
Stewart A. Fox 31 Dec. 1965 93 p refs
(Contract OCD-05-63-183)
(Rept.-899085; AD-634040) CFSTI: HC $3.00/MF $0.75

The report contains engineering and performance data on a prototype remote automatic monitoring system designed for use in local emergency operating centers. The development effort included but was not limited to design and construction of a detection system which transmits digital radiation data on command from a remote monitor location; incorporation of sensor station identification for serial line systems; production of one complete ten sensor station system for field evaluation. The system described will transmit data over commercial telephone lines and provide control for operation of radio frequency communication equipment. An investigation of data storage and retransmission systems was performed.
Author (TAB)

N66-33592# Ohio Univ., Athens. Research Inst.
ACOUSTIC INTERACTION FOR LINEAR AND PLANAR ARRAYS OF SMALL MAGNETOSTRICTIVE-STACK SONAR TRANSDUCERS AT AN AIR-WATER SURFACE Annual Summary Report
Folden B. Stumpf and Lawrence A. Crum 1 Jun. 1966 38 p refs
(Contract Nonr-4419(01))
(ASR-2; AD-633581) CFSTI: HC $2.00/MF $0.50

Experiments and theoretical developments for the acoustic interaction among small 20 kc/sec magnetostrictive-stack sonar transducers in linear arrays of two and three and planar arrays of three and four at an air-water surface are described. The interaction radiation resistance and reactance are studied as functions of number, spacing, relative position and relative phase of the transducers. Analysis and a graph are presented for source and sink regions for transducer operation as a function of spacing and relative amplitude. The theoretical development for this work is based on interacting dipoles in an infinite medium. It is hoped that the results of this study can be used in the design of more efficient sonar arrays.
Author (TAB)

N66-33652# Institute of Modern Languages, Washington, D. C.
DIRT ROADS AS AN INDICATOR IN THE AERIAL PHOTO INTERPRETATION OF SOILS AND TERRAINS
E. J. Alexeenko Jun. 1966 9 p Transl. into ENGLISH from Akad. Nauk SSSR, Lab. Aerometodov (Moscow), 1964 p 90-94
(Contract DA-44-009-AMC-1563(T))
(T-1847-66; TT-66-61441; AD-633940) CFSTI: HC $1.00/MF $0.50

The study of dirt roads and road networks in aerial photographs to determine the soil and terrain conditions is described. Roads in sandy soils are identified by the absence of long-standing pools and deep ruts, and by broad, much travelled areas. Dirt roads in loamy terrain are usually straighter, are badly broken up, have deep ruts, and pools, and the surrounding vegetation is often covered with dust. Marshy areas and bogs are indicated by dark areas bypassed by roads, ground water discharges, the absence of straight roads and populated areas, and logs for corduroy roads. Seasonal variations and geological features, such as mountains, are also mentioned.
N.E.N.

N66-33771*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RADIATION MEASUREMENT TECHNIQUES
Wesley A. Menard and George M. Thomas 1 Aug. 1966 32 p refs
(Contract NAS7-100)
(NASA-CR-77089; JPL-TR-32-975) CFSTI: HC $2.00/MF $0.50 CSCL 14B

This report describes quantitative radiation measurement techniques developed for use in an electric arc-driven shock tube. Shock layer radiance in the 0.3 to 2.7 μ region is measured using a carbon-coated thin film gage. The methods of calibrating the gage and of relating the gage response to the gas intensity are described. Two techniques for measuring the shock layer thickness are presented. The effects of shock wave attenuation and radiation from sources outside the shock layer are shown to be important in certain thermochemical regimes. Prism and grating monochromators have been adapted to the shock tube and used to measure spectral radiation in the 2000-10,000 Å region, with resolution as high as 1Å. The methods described have been applied in experimental studies of oscillator strengths, and nonequilibrium and equilibrium radiation. Absolute intensity measurements of the cyanogen violet band system produced in a carbon arc calibration source are also presented. In the ultraviolet region of the spectrum, stray light interference is a common problem. Techniques to eliminate the stray light such as using filters, fluorescent coatings, and solar blind detectors are discussed.
Author

N66-33810# General Motors Corp., Santa Barbara, Calif. Sea Operations Dept.
PORTABLE FIELD RECORDING SYSTEM
May 1966 21 p
(Contract Nonr-4298(00); Proj. Vela Uniform)
(TR66-18; AD-633838) CFSTI: HC $1.00/MF $0.50

The portable field recording system is a multi-channel device that will record, unattended, for 24 hours in a frequency band from dc to 313 Hz. The system can operate without preempting a patch panel terminal, because female connectors are pigtailed in parallel with each signal input cable jack. Prime power for the system can be furnished by either a 12-Vdc source or a 115-Vac, 60-cycle source.
Author (TAB)

N66-33821# IIT Research Inst., Chicago, Ill.
SOIL STRAIN GAGE INSTRUMENTATION Final Report, May 1964-May 1965
W. B. Truesdale and R. B. Schwab Kirtland AFB, N. Mex., AF Weapons Lab., Apr. 1966 97 p refs
(Contract AF 29(601)-6410)
(IITRI-M6082; AFWL-TR-65-207; AD-633887) CFSTI: HC $3.00/MF $0.75

Soil strain gage instrumentation was developed for the measurement of static and dynamic strains when embedded in soil. The gage is suitable for both laboratory and field application. The strain sensor consists of two mechanically uncoupled flat-coil disks which are embedded in the soil in near parallel and concentric orientation. The remainder of the gage comprises an identical set of coils positioned external to the soil as a standard reference, specially designed electronic driving, amplifying, and recording circuitry, and a precision micrometer coil mount. Soil deformations are determined by the resulting change in spacing of the embedded coil disks sensed as changes in mutual coil inductance. The gage is a reliable precise measuring device which is well suited for the measurement of strain in soil.
Author (TAB)

N66-33847# Joint Publications Research Service, Washington, D. C.
CHECKING AUTOMATIC POTENTIOMETERS

L. A. Musyakov 14 Jul. 1966 17 p refs Transl. into ENGLISH from Tr. Gos. Okeanogr. Inst. (Moscow), v. 87, 1965 p 166–173
(JPRS-36485; TT-66-32917) CFSTI: $1.00

A substantiation is presented for the need for regular observations to check proper operation of automatic potentiometers used as meters, and the importance of regular verification of the potentiometers is discussed. The primary factors in potentiometer inspection are also considered. Author

N66-33849# Army Engineering Geodesy, Intelligence and Mapping Research and Development Agency: Fort Belvoir, Va.
TEST AND EVALUATION OF THE PROTOTYPE SIDE-LOOKING RADAR RESTITUTOR Technical Report, May 1962–Nov. 1963
Clifford J. Crandall Apr. 1966 59 p
(Rept.-29-TR; AD-633610) CFSTI: HC $3.00/MF $0.75

This report covers the testing and evaluation of the prototype side-looking radar restitutor to determine its capability to correct for distortions caused by slant range, including earth curvature, systematic errors, sweep delay, tracking of the flight line, and line-of-flight deviations and presents data on the accuracy of the instrument. The report concludes that: (a) The prototype instrument does not meet the accuracy requirements specified in the contract; however, conclusive tests could not be conducted. (b) This instrument is definitely not an operational item. (c) The electronics are reliable. (d) The design can be improved in many places. These have been noted in the event of future development. With these improvements it may be possible that restitution can be accomplished within the prescribed horizontal accuracy requirements for 1:250,000-scale planimetric maps. Author (TAB)

N66-33899# Kernforschungsanlage, Juelich (West Germany). Institut fuer Neutronenphysik.
THE ROTATING CRYSTAL TIME-OF-FLIGHT SPECTROMETER FOR SUBTHERMAL NEUTRONS OF THE FRJ-2 [DAS DREHKRISTALL-FLUG-ZEITSPEKTROMETER FUER SUBTHERMISCHE NEUTRONEN AM FRJ-2]
A. Axmann and W. Gissler Dec. 1965 20 p refs In GERMAN
(JUL-338-NP)

The construction and operation of the rotating crystal time-of-flight spectrometer for subthermal neutrons is described. The rotating crystal is considered in some detail. The counter and electronic equipment are indicated. The resolution of the spectrometer was calculated. The methods used for the data processing are reviewed. The first measurements carried out with the time-of-flight spectrometer had the purpose of detecting the low energy transitions found previously on aqueous hydrofluoric solutions with the inverse beryllium filter method. Author (NSA)

N66-33909# Union Carbide Nuclear Co., Oak Ridge, Tenn. Y-12 Plant.
INDUSTRIAL INTERFEROMETRY
L. G. Whitten 22 Apr. 1966 44 p Presented at Meetings of the Am. Soc. of Tool and Mfg. Eng., Ch. 107, Knoxville—Oak Ridge, Tenn., 7 Oct. and 4 Nov. 1965
(Contract W-7405-ENG-26)
(Y-KE-194; CONF-651072-1) CFSTI: HC $2.00/MF $0.50

An introduction to interferometry and wave interference effects is presented. Light sources for interferometric measurements are discussed. Industrial uses of interferometric measurements are described. NSA

N66-33940# Laboratoire de Recherches sur la Physique des Plasmas, Lausanne (Switzerland).
BERYLLIUM PRESSURE BAR HAVING A SUBMICROSECOND RISETIME
Ieuan R. Jones Feb. 1966 15 p refs
(CRP-20/66)

The theoretical response of a pressure bar gauge to step-pressure loading was examined experimentally. Theory predicts that a pressure bar constructed from beryllium should have a risetime substantially faster than that of any previous pressure bar gauge described in the literature. Such a gauge was constructed and subjected to step-pressure loading; the time taken for the output signal to increase from 10 to 90% of its final steady value was 0.54 μsec. Author (NSA)

N66-33954# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics.
ALPHA DECAY FROM HIGHLY EXCITED STATES OF SM ISOTOPES
I. Kvitek and Yu. P. Popov 1966 3 p refs
(JINR-P-2625)

A review of the general methods of detection of particles is given. Particular attention is paid to filament chambers. The universal system proposed by Giannelli with magnetostrictive filaments is discussed and illustrated. The system with auxiliary magnetostrictive filaments for reading proposed by Perez-Mendez is likewise illustrated. The electrode chamber with electromagnetic retarding lines proposed by Charpak is discussed. Ambiguities in the localization of multiple traces in these geometries are pointed out, and a new system which permits determination of x and y in one plane for several signals is proposed. The method for reconstruction of the positions of three events using this new system is illustrated for the general case and for three degenerate cases. The problem of insoluble ambiguities is greatly reduced by this method; a prototype of the system is under construction. It will be capable of reconstructing several events on a plane of area 0.1 m^2. NSA

N66-33957# Brookhaven National Lab., Upton, N. Y.
NUCLEAR STRUCTURE MEASUREMENTS WITH THE BROOKHAVEN COSMOTRON
J. L. Friedes, H. Palevsky, R. J. Sutter, G. W. Bennett, R. L. Stearns et al Feb. 1966 13 p
(Contract AT(30-2)-GEN-6)
(BNL-10135; CONF-660209-4)

An investigation was made on the Brookhaven Cosmotron to determine whether the energy resolution and energy stability of the machine are adequate for nuclear structure measurements. An experimental setup employing the Cosmotron is described. Preliminary results from this setup are described. NSA

N66-33961# Laboratoire de Recherches sur la Physique des Plasmas, Lausanne (Switzerland).
STUDY OF THE PRECISION OF MEASUREMENTS IN PHOTOGRAPHIC SPECTROSCOPY [ETUDE DE LA PRECISION DES MESURES EN SPECTROSCOPIE PHOTOGRAPHIQUE]
J. Durand Apr. 1966 16 p refs
(LRP-24/66)

Light intensity measurements using photographic plates can give large errors when the development is carried out according to the instructions of the manufacturer (Eberhard's effect). This work determines experimental conditions under which good results can be obtained. It appears that the photo-

graphic method can give results with an average accuracy of 10%. Author (NSA)

N66-33964# Battelle-Northwest, Richland, Wash.
NUCLEAR TECHNIQUES IN NONDESTRUCTIVE TESTING
Charles N. Jackson, Jr. Mar. 1966 21 p Presented at the Intern. Standards Assoc., Northwest Instr. Conf. and Exhibit, Richland, Wash.
(Contract AT(45-1)-1830)
(BNWL-SA-646; CONF-660526-1) CFSTI: HC $1.00/MF $0.50

Three nuclear systems are described for nondestructive testing: a gamma spectrometer; an alpha counter; and an X-ray fluorescence method. A single channel analyzer combined with a gamma scintillation detector system was developed to monitor the enrichment of ^{235}U in uranium fuel elements. With a gamma count of 2 min the test system has an accuracy of about 0.1 wt % over a 0.05 to 3.0 wt % enrichment range. An alpha scintillation counter with an accuracy of about 25% at the 100 microgram contamination level was developed to test production fuel elements for uranium as a surface contaminant. The X-ray fluorescence investigation established that variations of the weld surface limited the threshold of sensitivity for detecting uranium as a possible contaminant. The prototype measured uranium contamination over a range from about 2 to 10 wt % when testing a small volume (0.25×10^{-3} in^3) at a scan rate of 5 in./min. NSA

N66-33969*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INSTRUMENT SYSTEM FOR DETERMINING TEMPERATURE EFFECTS ON MAXIMUM INDUCTION OF MAGNETIC MATERIALS
Anthony C. Hoffman Washington, NASA, Aug. 1966 16 p refs
(NASA-TN-D-3568) CFSTI: HC $1.00/MF $0.50 CSCL 20M

An instrument system for continuous measurement of maximum induction of magnetic materials as a function of temperature is described. To obtain continuous data, sinusoidal alternating-current excitation of the magnetic materials was used. An experimental evaluation of the effect of losses on overall accuracy was made. The hysteresis loss had no measurable effect which means that both hard and soft magnetic materials may be tested with this system. The eddy current loss does cause an error in maximum induction; however, this error can be minimized by operation at the proper frequency. The final result is a system that can continuously record maximum induction as a function of temperature with an error of $< \pm 1$ percent of full scale. Author

N66-33986# Lyon Univ. (France). Institut de Physique Nucleare.
STUDY AND DEVELOPMENT OF AN EXPERIMENTAL APPARATUS FOR THE MEASUREMENT OF ANGULAR DISTRIBUTIONS, EFFECTIVE CROSS SECTIONS, AND POLARIZATION IN SOME (p,p) REACTIONS. APPLICATION TO THE ELASTIC SCATTERING $^{12}C(p,p)^{12}C$ BETWEEN 1.95 AND 1.23 MeV [ETUDE ET REALISATION D'UN DISPOSITIF EXPERIMENTAL DE MESURES DE DISTRIBUTIONS ANGULAIRES, DE SECTIONS EFFICACES ET DE POLARISATION DANS CERTAINES REACTIONS (p,p). APPLICATION A LA DIFFUSION ELASTIQUE $^{12}C(p,p)^{12}C$ ENTRE (1.95 ET 1.23 MeV)]
Jean-Marie Lebre (Ph.D. Thesis) Mar. 1966 114 p refs In FRENCH
(LYCEN-6610)

An experimental device for the measurement of the angular distributions, effective cross sections, and polarization in (p,p) reactions was described. After a brief but theoretical review, the method was used for the measurement of polarization is described. The apparatus constructed is described in detail with particular emphasis on the double scattering polarimeter with carbon analyzer and the electronic detection circuits. The experimental method used in the measurement of the polarization is described in detail. The results obtained are reported for energies above 2 MeV. The experimental results obtained with carbon for energies between 1.5 and 2 MeV at angles of 45° are in good agreement with theoretical predictions. NSA

N66-33999# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
EFFECT OF BACKGROUND LOADING ON SPARK CHAMBER EFFICIENCY [VLIYANIE FONOVOI ZAGRUZKI NA EFFEKTIVNOST ISKROVOI KAMERY]
A. S. Vovenko, M. Ya. Vyrenkova, Ya. Gladki, B. N. Gus'kov, A. L. Lyubimov et all 1966 8 p refs In RUSSIAN Submitted for Publication
(JINR-P-2661)

The efficiency of a multiplate spark chamber is investigated under conditions of large background loading. It is shown that the recording efficiency of "starting" particle falls, when the background particle has gone through the spark chamber after "starting" particle, but before the high-voltage pulse was applied to the chamber. The more is the time interval between the starting and background particles, the stronger is the effect of the background particles on the recording efficiency of the starting particles. An explanation of this dependence is given and recommendations are suggested to increase the spark chamber efficiency under unfavorable background conditions. Author (NSA)

N66-34010# Martin Co., Baltimore, Md.
SYSTEM UTILIZATION
[1966] 334 p
(CPS-300)

Functional descriptions and panel illustrations are given for every control and display system for the Command Module and Lunar Excursion Module systems. These systems include flight control, stabilization and control, guidance and navigation, communications, antenna, mission sequence, emergency detection, service propulsion, cryogenics, environmental control, electrical power, warning, lighting, and reaction control. L.E.W.

N66-34029# Federal Aviation Agency, Atlantic City, N. J. Test and Evaluation Div.
LABORATORY TESTS OF SMALL LIGHTWEIGHT ALTITUDE TRANSMISSION EQUIPMENT (SLATE) Final Report
George H. Mahnken May 1966 85 p refs
(RD-66-36)

The performance characteristics of Small Lightweight Altitude Transmission Equipment (SLATE) were determined through laboratory tests. A description of the SLATE components is given, and the test procedures and results are presented. Each SLATE consisted of a transponder (receiver-transmitter), altimeter/digitizer, control box, and an antenna; and employed semiconductors and printed circuits to reduce size, weight, and power consumption. The transponders were subjected to test under controlled conditions; and the performance of the receiver and transmitter, and the side lobe suppression, decoding, echo suppression, and reply pulse circuits.

were determined. Results indicate that changes in the design of the transponders and altimeter/digitizers would be required in order to fully achieve the desired performance, but that production of this equipment is feasible. C.T.C.

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N66-32787*# Boeing Co., Seattle, Wash. Aerospace Group.
STATE-OF-THE-ART SURVEY OF DISSIMILAR METAL JOINING BY SOLID STATE WELDING
R. T. Torgerson, C. H. Crane, D. J. Lovell, and W. A. Baginski 27 Aug. 1965 50 p refs
(Contract NAS8-20156)
(NASA-CR-76933) CFSTI: HC $2.00/MF $0.50 CSCL 13H

General information is presented on processing, metallurgical techniques, diffusion phenomena, and solid state welding characteristics of similar and dissimilar metals. These data are reported in a review of pertinent information, a summary of state-of-the-art visits that were made, and an annotated bibliography. Dissimilar metal combinations considered in the study are stainless steel and aluminum, titanium, and nickel-base alloys. The review of solid state welding methods covers press bonding, roll bonding, gas-pressure bonding, explosive bonding, and resistance diffusion welding, but emphasis is placed on press bonding and roll bonding. Factors that are considered are time, temperature, pressure, intermediate materials, atmosphere, and surface condition and preparation. The joining of bare metals and joining with intermediate materials are also discussed. K.W.

N66-32799* Telecomputing Corp., Van Nuys, Calif. Whittaker Controls Div.
[LOW PRESSURE AIR PUMP 180025] Final Report
R. Kuberek 23 Feb. 1962 38 p *Its* Rept.-1109
(Contract NAS8-2432)
(NASA-CR-76918) CFSTI: HC $2.00/MF $0.50 CSCL 13K

Design modifications for improving the performance of a low pressure air pump are proposed. Original production objectives were the development of a pump which would provide a pneumatic source for air bearing applications in a closed loop system requiring low pressure and flow rate; the complete absence of contamination sources; high reliability; and efficiency. Pressure, flow, and power characteristics are depicted, and schematics are included. Design parameters evolved from preliminary tests are assessed. Based on these tests and the revised data analyses, three basic design changes are suggested: an increase in size of the permanent magnet; redesign of the check valves; and simplification and size reduction of the electronic control package. M.G.J.

N66-32803*# Tennessee Univ., Knoxville. Dept. of Mechanical and Aerospace Engineering.
ANALYSIS OF THE VISCO SEAL. PART II: THE CONCENTRIC TURBULENT CASE
William K. Stair and Robert H. Hale 28 Jun. 1966 99 p refs
(Grant NsG-587)
(NASA-CR-76866; ME-66-587-7) CFSTI: HC $2.50/MF $0.75 CSCL 13K

In a theoretical analysis of visco seal operation in turbulent flow, the general approach taken was to modify the Navier–Stokes equations. The velocity profile in the seal was represented as a power series and a solution of the resulting flow equations resulted in an equation for the sealing coefficient suitable for laminar or turbulent flow. An approximate method has been devised wherein the friction data for ordinary pipe flow can be utilized to determine the experimental factors in the sealing equation. From the experimental study of 10 seal geometries it was observed that the agreement between theory and experiment was quite satisfactory for purposes of seal design. Author

N66-32868# Oak Ridge National Lab., Tenn.
CODES AND NONDESTRUCTIVE TESTING OF WELDS
Edward C. Miller 25 Mar. 1966 16 p Presented at the 1st Midwest Welding Conf. Symp. on Nondestructive Testing, Chicago, 3 Feb. 1966
(Contract W-7405-ENG-26)
(ORNL-P-2107; CONF-660211-2) CFSTI: HC $1.00/MF $0.50

The history of the development of pressure vessel and piping codes is summarized and the problems involved in introducing new techniques, including nondestructive testing requirements, into these codes are described. These problems include the necessity for establishing procedures whose results are readily interpretable with a minimum of dispute, and capable of giving consistently reproducible results when employed by a variety of operators and shops with a variety of equipment and varying levels of ability. The generally good record of service performance of code-constructed equipment requires that the introduction of new techniques be justified on the basis of improved quality of construction consistent with the cost involved. The actual methods of nondestructive testing presently incorporated in Codes and their acceptance standards are reported in some detail. Author (NSA)

N66-32922*# SKF Industries, Inc., King of Prussia, Pa. Research Lab.
SUPERSONIC TRANSPORT LUBRICATION SYSTEM INVESTIGATION Third Semiannual Report, 1 Nov. 1965–1 May 1966
W. L. Rhoads and L. B. Sibley 20 May 1966 133 p refs
(Contract NAS3-6267)
(NASA-CR-54313; AL66T032) CFSTI: HC $3.00/MF $1.00 CSCL 13I

Ball bearings and bellows face seals for use on Mach 3 aircraft gas turbine engine mainshafts are being tested with several selected lubricants using both oil-mist and jet lubrication systems, with provisions for inert gas blanketing. Bearing operating temperatures of 600°F and higher are being explored under typical engine load and speed conditions with the seals exposed to 1200°F air and a pressure differential of 100 psi. Screening tests have proceeded in the recirculating rig with several candidate lubricants, and oil-mist testing has begun under heated conditions. Author

N66-32924*# Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.
DEVELOPMENT AND EVALUATION OF MAGNETIC AND ELECTRICAL MATERIALS CAPABLE OF OPERATING IN THE 800° TO 1600°F TEMPERATURE RANGE Third Quarterly Report, 1 Jun.–31 Aug. 1966

P. E. Kueser et al Sep. 1965 205 p refs
(Contract NAS3-6465)
(NASA-CR-54356; WAED-65.52E) CFSTI: HC $3.75/MF $1.25 CSCL 13H

Progress is reported in a program for the development and evaluation of magnetic and electrical materials capable of operation in the 800°F to 1600°F temperature range, and applicable to advanced space electric power systems. Martensitic alloys containing 12 nickel-20 cobalt-balance iron with single elements such as tantalum, molybdenum, niobium, beryllium, or titanium were investigated for rotor use. They indicated strong age-hardening response, and have higher alpha to gamma transformation temperatures than the 15-weight percent nickel alloys. The feasibility of high-temperature capacitors using high-quality dielectric materials was investigated. A combined multiple slicing-cleavage technique was developed for yielding 15 wafers of pyrolytic boron nitride from a 1/4-inch block, 1-inch square. Research developments on alkali-metal ceramic-to-metal seals and combinations of materials designed into a stator with a bore seal, a transformer, and a solenoid are included. C.T.C.

N66-32958*# De Bell and Richardson, Inc., Hazardville, Conn.
PRECISION WINDING OF CYLINDRICAL COMPOSITES WITH SHAPED GLASS FILAMENTS
Richard A. Humphrey Washington, NASA, Aug. 1966 44 p refs
(Contract NASw-1100)
(NASA-CR-517) CFSTI: HC $2.00/MF $0.50 CSCL 13H

During the continuation of the first year's effort on forming shaped and hollow glass filaments, the process was refined. Precision windings were made to obtain close packing from rectangular microtape, both solid and hollow, while hollow hexagonal fiber was wound into a micro-honeycomb. Substantial mechanical properties data were developed on 2.3" diameter tubes precision wound from solid microtape into 90% by volume glass structures. These displayed no room temperature permeability to water and modulus of elasticity values the same as the glass; namely, 10×10^6 psi. Axial strengths of the tubes with only circumferential windings were as high as 25,000 psi. Author

N66-32962*# Ampex Corp., Redwood City, Calif.
ANALYZATION, DESIGN, FABRICATION, AND TESTING OF A FOIL BEARING ROTOR SUPPORT SYSTEM Final Technical Report
Alan Huckabay and A. F. Staal Jun. 1966 111 p refs
(Contract NASw-1221)
(NASA-CR-76997; RR-66-21) CFSTI: $4.00/MF $0.75 CSCL 13I

For this study a self-acting, gas lubricated foil journal bearing rotor support system was designed and fabricated. The system was designed for a maximum rotational speed of 570,000 rpm and was instrumented to continuously measure shaft speed, shaft motion in two planes, foil tension, wrap angle, and the torque exerted by the rotating shaft on the foil journal bearing. The highest speed recorded while testing was 381,000 rpm, and at no time was half-frequency whirl observed. A study of the stress and vibration characteristics of high-speed rotors showed that rotor designs are often limited by the first free-free bending critical speed because conventional gas lubricated bearings cannot support a shaft during acceleration through this critical speed. Three rotors supported on self-acting gas lubricated journal bearings were accelerated up to a rotational speed corresponding to their free-free critical speed. There was no damage either to the shaft or to the foil journal bearings after operation at this critical speed. Author

N66-32965*# Martin Co., Denver, Colo.
INVESTIGATION OF THE RELIABILITY OF STERILE INSERTION TECHNIQUES FOR SPACECRAFT Monthly Letter Report, 23 Jun.-23 Jul. 1966
L. Sullivan Jul. 1966 48 p
(Contract NASw-1047)
(NASA-CR-76996; VOY-CR-66-8) CFSTI: HC $2.00/MF $0.50 CSCL 13H

Two isolator configurations were designed, one for sterile insertions and one for determining allowable hole sizes in isolators through which external contamination may enter. It is pointed out that sterile insertion techniques are necessary for the replacement or addition of sterile missile or spacecraft components on a sterile vehicle without violating overall sterility, or resorting to a dry heat sterilization cycle to reestablish overall sterility. A plan is outlined for demonstrating the feasibility of making sterile insertions by the sterile lock method, and the split seam method. Equipment and procedures are described for both methods. A test plan is also included to establish the requirements and methodology for determining the size of circular holes in bioisolators that will permit backflow microbiological contamination to enter the isolator from a contaminated area, and equipment and procedures are detailed. E.A.O.

N66-33123# United Kingdom Atomic Energy Authority, Risley (England). The Reactor Group.
BOLTED FLANGED JOINTS FOR HIGH-TEMPERATURE SERVICE
W. P. White and N. A. C. Bromidge 1966 72 p refs Revised (TRG-1208(R))

A new type joint was developed, using a thin soft metal gasket which is compressed plastically between controlled finish surfaces on the mating hubs. The new design can be used in practically any environment when the right choice of materials is made, and it remains substantially leak-tight at all temperatures up to 600°C, and in some cases higher temperatures. The joint will withstand pressures significantly greater than the safe working pressures of the adjoining pipes, and its performance is not impaired by alternating applied bending moments or torsion. The report gives the results of exhaustive tests made on several sizes of joints. The leak-rates of the joints tested were of the order of 10^{-9} atm/cm^3 sec per cm peripheral length of gasket, and were not measurably affected by changes of pressure. Complete detail designs are included for joints up to 6 in. in diameter, and sufficient design data are given for successful joints to be made in much larger sizes. Future requirements are anticipated for joints working at temperatures up to 1000°C and some suggestions are made for further development. Author

N66-33136# United Kingdom Atomic Energy Authority, Harwell (England). Metallurgy Div.
THE PREPARATION OF ULTRA-THIN AND VERY LARGE AREA PETROLOGICAL SECTIONS BY SEMI-AUTOMATIC METHODS
T. G. Jones, R. W. M. Hawes, and J. R. Dyson Mar. 1966 14 p
(AERE-R-5155)

The need for ultra-thin and large area petrological sections is explained. Semiautomatic methods of preparing these without hand finishing, using a commercially available surface grinder with special modifications, is described in detail. Large area sections have particular use in the examination of concrete, but other applications in the fields of industrial ceramics and geological science are indicated. Author

N66-33243# General Motors Corp., Kokomo, Ind.
PRODUCTION ENGINEERING MEASURE TO IMPROVE PRODUCTION TECHNIQUES AND INCREASE THE RELIABILITY OF THE SCL 7004/21 AND SCL7004/22 TRANSISTORS Quarterly Progress Report, Nov. 29, 1965–Feb. 28, 1966
R. P. Anjard [1966] 35 p refs
(Contract DA-36-039-AMC-06170(E))
(QPR-1; AD-633783) CFSTI: HC $2.00/MF $0.50

State-of-the-art SCL-7004/21 and SCL-7004/22 samples were supplied; a management plan—critical Path Plan (Gantt Modified) was submitted and the initial milestone tests were initiated for SCL-7004/20 type devices. Of the seven process improvements, three are being finalized; one is in the state of continuous improvement, two are being initiated and one is scheduled to start March 1, 1966. During this quarter, the Milestone I operating live test was 80% completed and the storage life test 90% completed. The results will be presented in the next quarterly report. Author (TAB)

N66-33302# Watervliet Arsenal, N. Y. Benét Labs.
PROCESS FOR ANODIZING TITANIUM
Theodore M. Pochily Apr. 1966 44 p refs
(WVT-6605; AD-633986) CFSTI: HC $2.00/MF $0.50

The requirements of an advancing technology in weaponry, aircraft, and aerospace have necessitated a consideration of light metals as a substitute for steel. In the search to reduce weight, and consequently increase mobility, titanium offers valuable assistance. The use of titanium as an engineering and structural material has been accepted for a comparatively short time. This acceptance was predicated on two important factors, strength/weight ratio and corrosion resistance. The tendency of titanium to gall and seize, when used as a bearing or mating surface, has restricted a full utilization of the metal. Work conducted at Watervliet Arsenal to develop a process that reduces or eliminates this condition was evaluated. Processing details, a summary of test data covering wear resistance, and the effects of the process on the mechanical properties of titanium are discussed. Author (TAB)

N66-33466# Beryllium Corp., Reading, Pa.
PRODUCTION ENGINEERING MEASURE FOR BERYLLIUM OXIDE AND PARTS PRODUCED FROM IMPORTED ORES Final Report, 1 Jul. 1963–30 Jun. 1965
J. K. Evans, H. F. Lebo, and J. F. Blum [1965] 115 p refs
(Contract DA-36-039-AMC-01481(E))
(AD-634354) CFSTI: HC $4.00/MF $0.75

The purpose of the study was to produce four typical electronic parts from beryllium oxide powder with mass production type facilities. The study involved the establishment of a powder processing facility to produce a uniform powder from batch to batch in production size quantities. The second phase of the study required the development of a pilot plant fabrication line to produce uniform parts from the powder. TAB

N66-33494*# Vickers, Inc., Troy, Mich. Research and Development Dept.
DEVELOPMENT OF A PROPORTIONAL TWO STAGE PRESSURE FEEDBACK PNEUMATIC VALVE FOR 2000°F SOLID PROPELLANT SYSTEMS Report, Jul. 6, 1965–May 20, 1966
Jul. 1966 121 p refs
(Contract NAS1-4102)
(NASA-CR-66156) CFSTI: HC $3.00/MF $1.00 CSCL 13K

Secondary flow amplification was applied for control of high primary pneumatic mass flows independent of extraneous internal valve flow and mechanical forces. Closed loop pressure feedback logic was incorporated to achieve functional static accuracy and dynamic response. Six flightweight prototype models were fabricated and then tested in both gaseous nitrogen and 2000°F pneumatic supply environments. An analog analytical study provided design parameters to optimize the dynamic response characteristics and flightweight design criteria. Analog investigations included scaled mass flow, system pressure levels, and capability potential for 5500°F solid propellant systems. Materials and design stress investigations were included for 5500°F systems. It is concluded that the concept of a flightweight proportional two-stage valve incorporating closed loop pressure feedback logic for high temperature solid propellant pneumatic systems is practical. Author

N66-33498*# Bendix Corp., Southfield, Mich. Research Labs. Div.
DESIGN, FABRICATION AND TEST OF A FLUERIC SERVOVALVE Quarterly Report, 28 Dec. 1965–28 Mar. 1966
C. E. Vos [1966] 39 p
(Contract NAS3-7980)
(NASA-CR-72023; BRLD-3395) CFSTI: HC $2.00/MF $0.50 CSCL 13K

A breadboard model of a pneumatic-input flueric servovalve, which operates with no moving parts, was designed and fabricated. Developmental tests of the power stage and an evaluation test of the breadboard servovalve were conducted, first using nitrogen as the working fluid, and then using hydrogen. The servovalve is designed to operate with H_2 at temperatures from 56°K (100°R) to 333°K (600°R), supply pressure of 148 N/cm^2 (215 psia), exhaust pressure of 34.5 N/cm^2 (50 psia), and maximum control pressure of 48.5 N/cm^2 (70.4 psia). Author

N66-33538*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE FABRICATION OF BERYLLIUM. VOLUME I: A SURVEY OF CURRENT TECHNOLOGY
Jul. 1966 149 p refs
(NASA-TM-X-53453) CFSTI: HC $3.00/MF $1.00 CSCL 13H

This report is concerned with the fabrication of beryllium and its alloys into space vehicle structures. The report summarizes currently used methods for fabricating the metal into sheets, rods, and other forms. Some of the difficulties that have been encountered in various aspects of fabrication, especially regarding the inherent brittleness of the metal, are enumerated along with the means that have been used to circumvent these problems. The survey includes 102 references to articles and papers in the unclassified literature, most of them having been published since 1960. Author

N66-33548# Nuclear Metals, Inc., West Concord, Mass.
FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. II: FABRICATION OF SEAMLESS TUNGSTEN AND TUNGSTEN-RHENIUM TUBING Summary Technical Report, 1 Jul. 1963–30 Jun. 1964
S. Isserow, J. G. Hunt, R. G. Jenkins, and A. L. Geary Washington, AEC, 15 Jun. 1965 249 p refs
(Contract AT(30-1)-2784)
(NMI-1284; NYO-2784-11) CFSTI: HC $6.00/MF $1.25

Extrusion and drawing techniques were developed for seamless tubing of unalloyed tungsten and tungsten–25 wt.% rhenium with diameters below about 0.4-inch. Billets filled with molybdenum were used for both compositions. Four warm drawing techniques were found to be feasible for both

materials. Significant progress in drawing resulted from the establishment of swaging as a practical method of pointing. The fabrication program was guided by metallurgical evaluations. Both wrought and annealed tubing were examined to determine their microstructures and mechanical properties, notably ductility as determined in the ring compression test. Author (NSA)

N66-33579# Rock Island Arsenal Lab., Ill. Research and Engineering Div.

LUBRICANT ADDITIVE EFFECTS UPON BEARING METAL FATIGUE. I: ROLLING CONTACT ADAPTATION FOR FOUR BALL EP TESTER

Max T. Fisher Apr. 1966 27 p refs

(RIA-66-1293; AD-634112) CFSTI: HC $2.00/MF $0.50

A rolling contact adaptation of the Four Ball Extreme Pressure Tester was devised and evaluated for its utility in determining the effects of additives in oils on the fatigue life of 52,100 steel balls. Six compounds, similar in molecular size to common additives but selected for different configurations and functional groups, were combined with low viscosity (80 SUS at 100° F) paraffinic and naphthenic oils in 5% concentrations. Their effects upon fatigue, compared with that of the oils alone, were determined. Molybdenum disulfide was also evaluated in the same manner. Based on fewer tests than statistically desirable, the 10% life taken from Weibull distribution plots of the results indicate that different additives and lubricant bases have varying effects upon the fatigue life of bearings. It appears that reasonably fast, economical and reliable ball bearing fatigue life results can be expected with this relatively inexpensive rolling contact adaptation of the widely used Four Ball EP Tester. Author (TAB)

N66-33603# General American Transportation Corp., Niles, Ill.

FRICTION LOSS IN FLEXIBLE PLASTIC AIR DUCT

Robert B. Neveril and Herman F. Behls Oct. 1965 37 p refs

(GARD-1278-2; AD-632984) CFSTI: HC $3.00/MF $0.75

Tests were conducted to determine the pressure drop-characteristics of 20-inch diameter, 4-mil thick, polyethylene tubing and both factory and shelter fabricated 90-degree elbows. The tests were performed at flow rates ranging from 1300 to 4100 cubic feet per minute. These plastic components are part of a portable ventilation system that was developed for civil defense fallout shelters, specification MIL-V-40645. Fully inflated 20-inch diameter plastic tubing has about three-quarters of the pressure drop of sheet metal duct. However, the last fifty feet of a plastic duct system, which is not completely inflated, has 1-1/2 to 3 times the pressure drop per foot of fully inflated plastic tubing. The result is that for duct systems over 100 feet long the pressure drops for sheet metal and plastic tubing are approximately the same. The friction losses for both factory fabricated and shelter fabricated elbows were established. A 40-inch, smooth radius, 90-degree factory fabricated elbow is recommended for use with the Civil Defense package ventilation kit. This elbow develops a pressure drop equivalent to 50 feet of straight tubing. The best shelter fabricated elbow is a three-piece elbow with a radius of 60 inches that can be fabricated from the straight tubing and tape stocked in the package ventilation kit. This elbow develops a pressure drop equivalent to 90 feet of straight tubing.

Author (TAB)

N66-33628# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ELECTROMAGNETIC PUMPS FOR ALKALI METALS

N. I. Marin, V. A. Tousten, T. V. Koktorova, and Ye. M. Avilova 20 Jan. 1966 11 p Transl. into ENGLISH from Atomnaya Energ. (Moscow), v. 18, no. 3, 1965 p 239-242

(FTD-TT-65-1456/1+2+4; AD-633536) CFSTI: HC $1.00/MF $0.50

Results are given for the development of a series of electromagnetic spiral pumps for laboratory purposes with a productivity of 0.1–150 cu m/hour. TAB

N66-33647# Navy Dept., Washington, D. C.

TIGHTENING FLANGE JOINTS BY MEANS OF HERMETICALLY SEALING PLASTIC [UPLOTNENIYE FLANTSEVYKH SOYEDINENIY S POMOSHCH'YU GERMETIZIRUYUSHCHEY PLASTMASSY]

Yu. V. Razdrogin 1965 5 p Transl. into ENGLISH from Sudostroyeniye (Leningrad), no. 1965 p 76–77 *Its* Transl. 2095

(TT-66-61431; AD-633895) CFSTI: HC $1.00/MF $0.50

Unusual watertightness of flange joints is obtained by placing a suitable packing between the tightening flanges. Additional adjusting work in assembling flange joints may be avoided by using a special binding plastic deposited on the tightening surfaces of the flanges which fills all the micro- and macro-irregularities when tightening the flanges with the joining bolts. Under such conditions the plastic must be self hardening. The indicated requirements are met by hermetically sealing plastic based on an epoxy resin mark ED-5 (TU LSNKh no. 33029-59) and an epoxy putty mark EPOOIO (GOST 10277-62). Polyethylenepolyamin (VTU MKhP No. P-10-57) serves as the hardening agent, portland cement 500 (GOST 965-41) and chopped glass fiber (VTU no. 836-60) as fillers. A hermetically sealing plastic is resistant to vibration and impact loads, and to oil and gasoline and as a consequence of its insignificant shrinking it maintains relatively stable condition of the joined flanges. TAB

N66-33654# United Aircraft Corp., East Hartford, Conn.

INVESTIGATION OF A PROCESS FOR THE PRODUCTION OF METALLIC FILAMENTS Final Technical Report, 9 Apr. 1965–8 May 1966

R. D. Veltri and J. E. Cox 8 Jun. 1966 45 p refs

(Contract NOw-65-0447-d)

(E910342-5; AD-633527) CFSTI: HC $2.00/MF $0.50

The process investigated involves the continuous casting of beryllium metal as a core material in a glass capillary as the capillary is continuously drawn from glass tubing. The vigorous reaction between molten beryllium and glass prevented successful development of this process, and most of the effort was spent in studying means of introducing molten beryllium into the core of glass fibers with a minimum reaction time. Some glass compositional studies were also made in an effort to improve the compatibility between beryllium and glass at high temperature. A pressure ejection technique of squirting a stream of molten beryllium vertically downward from a beryllium oxide nozzle into the cone of glass fiber formation appeared to be the most promising method for reducing the reaction time. Problems involving beryllium-glass reaction, control of metal flow, nozzle design, heating techniques and material purity must be overcome before this process can succeed. The glass compositional study has given encouraging results. Experimental glasses, used as an intermediate layer between the beryllium and the conventional fiberizing glass, appeared to reduce the severity of the usual beryllium-glass reaction. The extent of this investigation has been too limited to warrant any definite conclusions. Author (TAB)

N66-33672*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PUMP TECHNOLOGY
I. Irving Pinkel, Melvin J. Hartmann, Cavour H. Hauser, Max J. Miller, Robert S. Ruggeri et al *In its* Selected Technol. for the Petrol. Ind. 1966 p 81–101 refs (See N66-33666 19-34) GPO: HC $1.25; CFSTI: MF $0.50

High performance turbopumps and the role of cavitation in defining pump performance limits are discussed, with the emphasis on pumping near-boiling liquids. Types of rocket pumps are briefly reviewed, and an analysis of pump flow is presented. Details are given on the role of an inducer just upstream from the main pump to produce a pressure rise sufficient to allow the first axial flow stage without cavitation. Cavitation damage to pump blade and inducer is described, and cavitation erosion rates for a number of materials are presented. Failure from flow instabilities incurred by cavitation are also discussed. N.E.N.

N66-33673*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LUBRICANTS, BEARINGS, AND SEALS
Edmond E. Bisson, William J. Anderson, Robert L. Johnson, Erwin V. Zaretsky, and Lawrence P. Ludwig *In its* Selected Technol. for the Petrol. Ind. 1966 p 103–123 refs (See N66-33666 19-34) GPO: HC $1.25; CFSTI: MF $0.50

The influence of extreme environments on the operation of bearings and seals is described. The environments are extremely high or low temperature, vacuum, and contact with fluids chemically active toward the bearing and seal materials. Hydrodynamic and hydrostatic films, which separate surfaces in relative motion, are reviewed. Boundary lubrication films for use under contacting conditions, and solid lubricant films to provide low friction and surface protection are also mentioned. Rolling element bearings are discussed with respect to lubrication and fatigue. The advantages and disadvantages of gas bearing are identified, and various face contact seals are described. It was concluded that (1) solid lubricant coatings and built-in lubricants are satisfactory for limited life applications, and (2) for long-life operation, both bearings and seals require that their load-carrying surfaces be completely separated by fluid films. N.E.N.

N66-33674*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STORAGE AND HANDLING OF CRYOGENIC FLUIDS
Donald L. Nored, Glen Hennings, Donald H. Sinclair, Gordon T. Smith, George R. Smolak et al *In its* Selected Technol. for the Petrol. Ind. 1965 p 125–153 (See N66-33666 19-34) GPO: HC $1.25; CFSTI: MF $0.50

Technology pertinent to the general use of cryogenic fluids is discussed, with emphasis on cryogenic propellants. Properties of fluids at 1 atmosphere are listed, and the propellant production and handling are described. The special technology connected with structural materials for cryogenic temperatures, and their changes due to low temperatures are described. Characteristics of metals and fiber glass filament wound composites are presented. Insulation of tanks is discussed, and sensors for temperature, pressure, and liquid level measurements are described. N.E.N.

N66-33715# Royal Aircraft Establishment, Farnborough (England).
TRANSIENT RESPONSE TESTS ON SATELLITE POPPET VALVES
K. J. O'Mahony Mar. 1966 25 p
(RAE-TR-66109) CFSTI: HC $1.00/MF $0.50

The transient response of poppet valves designed in the R.A.E. for use in satellite gas jet attitude control systems has been investigated. Measurements have been made at various power levels on the standard form of the valve and also on a slightly modified version designed to operate at a lower power level. Oscillograms of the transient response and a table of results are given in this note. A method of reducing the valve opening time without increasing the steady state power consumption is suggested. Measurements have been made on the transient response of this system which involves discharging a capacitor through the torque motor at the instant of thrust demand. The advantages and limitations of this system are briefly indicated. Author

N66-33716*# Midwest Research Inst., Kansas City, Mo.
SOLID LUBRICANTS Technology Survey
M. E. Campbell, John B. Loser and Eldon Sneegas Washington, NASA, May 1966 114 p refs Prepared for NASA
(NASA-SP-5059) GPO: HC $0.50; CFSTI: MF $0.75 CSCL 11H

Advantages, disadvantages, and the history of solid lubrication are briefly reviewed. Of the bonded types, resin bonded and inorganic bonded solid film lubricants are discussed. A listing of military and industrial specifications includes lubricants of the following types: molybdenum disulfide powder, grease, and oil; graphite; heat cured and air dried solid film; dry film ceramics; and silicon base. Development of several new lubricants by government agencies and industry is mentioned. The use of composites, powders, and plastics as lubricants is discussed. Friction and wear testing machinery is listed and evaluated. Among environmental effects on solid lubricants that are covered are normal and extreme atmospheric conditions, loading, temperature, and radiation. Applications of the in-situ process, electrophoretic deposition, and flame spraying are presented. The use of solid lubricants by the military services, the aerospace industry, and in commercial applications is pointed out. Tables, illustrations, and a detailed bibliography are included. K.W.

N66-33854# Chrysler Corp., Detroit, Mich. Defense Operations Div.
POLYETHYLENE LINED TURRET Final Report
22 Jun. 1966 92 p
(Contract DA-20-113-AMC-07809T)
(AD-633944) CFSTI: HC $3.00/MF $0.75

A production technique was sought for lining a tank turret with high-density polyethylene by an extrusion process for radiation protection. Several problems were encountered including: (1) the construction of the liner in the turret; (2) the extruding of the polyethylene into the sample boxes without forming voids and cracks; and (3) void detection methods. It was found that temperatures, pressures and annealing procedures were very critical in obtaining satisfactory samples. Construction of the liners was important to the flow of the plastic. Seven sample boxes were filled with polyethylene by the extrusion method and none of them were completely satisfactory. It was concluded that the extrusion method of filling a turret liner with polyethylene would not result in a void-free, crack-free liner due to the very critical temperatures, pressures and annealing procedures. The construction and internal configuration of the liners is an important factor in the free flow of the plastic. It is recommended that other methods such as using polyethylene sheets or pouring a polymer liquid into a liner form be given consideration. Author (TAB)

N66-33880# Sandia Corp., Albuquerque, N. Mex.
GEOMETRIC MEANS OF SPALL PREVENTION
Robert M. Donner Apr. 1966 24 p refs Submitted for Publication
(Contract AT(29-1)-789)
(SC-RR-66-134) CFSTI: HC $1.00/MF $0.50

The resistance of metal plates to spalling can be increased considerably by certain changes in the geometry. Drilling holes in copper and aluminum targets raised the stress input necessary for spalling about one order of magnitude. The holes may collapse and form high velocity jets under certain conditions. The experimental configuration and the results are presented in detail. Author (NSA)

N66-33977*# Aerojet-General Corp., Sacramento, Calif. Liquid Rocket Operations.
SUMMARY OF MATERIALS TECHNOLOGY OF M-1 ENGINE
G. R. Janser 22 Jul. 1966 85 p refs
(Contract NAS3-2555)
(NASA-CR-54961; AGC-8800-64) CFSTI: HC $2.50/MF $0.75 CSCL 13H

A compilation of materials engineering tasks of limited scope performed in support of the M-1 Engine Program is presented. These tasks include the determination of cryogenic properties of selected materials, welding of AISI 347 stainless steel to Inconel 718, fabrication properties of Rigimesh, and cryogenic property evaluations of wrought and cast 5Al-2.5-Sn-ELI titanium for pump inducers. The major materials studies are reported separately and are referenced. Author

N66-33986# National Academy of Sciences—National Research Council, Washington, D. C. Materials Advisory Board.
(METALWORKING PROCESSES AND EQUIPMENT) Third Progress Report, Mar.–Oct. 1965
31 Oct. 1965 26 p refs
(MAB-206-M(3)) CFSTI: HC $2.00/MF $0.50

The state of knowledge of the following aspects of metal processing are reviewed: lubrication in metal working, application of deformation theory to practice, limitations of the extrusion processes, and thin sheet rolling. NSA

N66-34012# Bureau of Ships, Washington, D. C.
SECURING MACHINERY IN PLASTIC VESSELS
Iu. V. Razdrogin [1965] 148 p refs Transl. into ENGLISH from the book "Krepleniye Mekhanizmov Na Sudah Iz Plastmass" Leningrad, Sudostroyeniye, 1965 *Its* Transl. No. 963 (TT-66-61238; AD-632604) CFSTI: HC $4.00/MF $1.00

The book examines the methods for securing machinery in plastic ships. It describes briefly the materials used in the building of plastic ships, and the existing constructions of foundations. It describes experiments of securing machinery to foundations and expounds a methodology for the calculation of securing machinery and of other saturation in plastic ships. It describes the technology of premouldinq foundations to plating of hull in plastic ships, of mounting the securing of machinery and of other saturation. It examines problems quality control of materials and those of techniques for safety in working with fiberglass. Author (TAB)

N66-34048*# Illinois Univ., Urbana. Coordinated Science Lab.
AN EVALUATION OF A BAKEOUT PROCEDURE FOR SMALL GLASS ULTRAHIGH VACUUM SYSTEMS
Fortunat Steinrisser Jun. 1966 17 p refs
(Grant NsG-376; Contract DA-28-043-AMC-00073(E))
(NASA-CR-77252; R-299; AD-634592) CFSTI: HC $1.00/MF $0.50 CSCL 13H

A bakeout procedure for small glass ultrahigh vacuum systems is described which insures pressure well below 10^{-11} torr. An optically dense zeolite trap and a valve were placed between diffusion pump and system. The trap was baked whenever it was loaded with gas, i.e., after glassblowing, system bakeout, and outgassing of the ion gauges. The valve between trap and system was kept closed during bakeout of the trap. During bakeout of the system, outgassing of the ion gauges, and regular operation of the system, the trap was refrigerated at liquid nitrogen temperature. The observed partial pressures are given. Atmospheric He diffusing through the Pyrex glass and H_2 diffusing out of metal parts were the dominant residual gases. CO production during O_2 admission was small in comparison to processing without use of the isolation valve. Author (TAB)

N66-34086*# IIT Research Inst., Chicago, Ill.
GRAPHITE–METAL COMPOSITES Final Report, 1 Aug. 1965–31 Jul. 1966
Y. Harada 1 Aug. 1966 110 p refs
(Contract NASr-65(09))
(NASA-CR-77114) CFSTI: HC $4.00/MF $0.75 CSCL 13H

Hot pressed metal carbide–graphite composites, incorporating carbides of titanium, zirconium, hafnium, vanadium, niobium, tantalum, molybdenum, or tungsten with compositional ranges of up to 90 wt%, were studied. Processing temperatures varied from 2600° to 3200°C, and the effects on physical and mechanical properties up to 2800°C were determined. Needle cokes were found to be preferable to spherical particle graphite sources in achieving rapid densification. At 50 wt% metal level in any system, hot pressing just below the eutectic temperature produces composites having room temperature strengths of over 10,000 psi. The metal phase enhances ordering of the graphite phase, and improved bonding occurs through liquid phase sintering and/or diffusion bonding. High temperature behavior is related to the liquification temperature. An essentially linear relationship between electrical resistivity and flexural strengths is reported. Author

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N66-32757*# Wheeler Labs., Inc., Great Neck, N. Y.
DEVELOPMENT OF OPTICAL WAVEGUIDES AND COMPONENTS Progress Report No. 1339, Feb. 1966–Mar. 1966
E. Ronald Schineller and Donald W. Wilmot 14 Apr. 1966 113 p refs
(Contract NAS-12-2)
(NASA-CR-76893) CFSTI: HC $3.00/MF $0.75 CSCL 20E

Waveguide directional couplers and a waveguide laser are studied for the purpose of developing a large-sized waveguide with components that operate in a single-mode manner. Implementation of slot-type couplers is described and a coupling ranging from 7 to 17 dB is demonstrated. Testing of an evanescent-field coupler is reported. The experimental waveguide laser, which comprises a core of Nd-doped glass and a liquid cladding, is illustrated. Near- and far-field radiation characteristics of the laser, pumped below threshold, indicate

an intense directed beam at a wavelength of 1.06 microns caused by directed fluorescence. The feasibility and practicality of all-solid waveguide components is experimentally confirmed. S.P.

N66-32847# Stanford Research Inst., Menlo Park, Calif.
DETECTION OF CEMENT DUST CLOUDS WITH A PULSED RUBY LIDAR, PHASE I
Myron G. H. Ligda 4 Mar. 1966 21 p
(Contract AT(04-3)-115)
(UCRL-13204) CFSTI: HC $1.00/MF $0.50

An experiment conducted at Test Site 300 on 5 February 1966 in which the SRI lidar was used to detect clouds of cement dust dispensed by helicopter was entirely successful. The lidar operated satisfactorily under somewhat adverse weather conditions, the cement clouds were detected well after they had dispersed below visibility (even as viewed against a white cloud background), and the experimental conditions approximated to some degree those that might be encountered at the Nevada Field Site. Based on the signal-to-noise ratios observed at close ranges, if the reflectivity of the cement dust clouds approximates that of the dust cloud produced by a nuclear explosion, it should be possible to detect the latter at ranges well over 10 miles with this same equipment. Larger ranges could be expected if the dust cloud contains a higher concentration of particles, larger size particles, and/or some particles of crystalline form such as quartz, mica, or ice, which will produce strong specular reflections. The primary limitation of the lidar is its low firing rate (about 2 per minute, maximum). NSA

N66-33273# Yeshiva Univ., New York. Belfer Graduate School of Science.
LASER PHASOGRAPHY OF JETS, SHOCKS AND PLASMAS Scientific Report No. 1
Herman M. Presby 1 Apr. 1966 114 p refs
(Contract AF 19(628)-2399)
(AFCRL-66-299; AD-633703) CFSTI: HC $4.00/MF $0.75

The phase-contrast microscope of Zernike may be scaled in size and combined with "giant pulse" ruby laser illumination to make possible the observation of macroscopic moving tenuous objects, such as jets, shock waves and plasmas. The resulting instrument, referred to as the Laser Phase Macroscope (L.P.M.), has performance similar to that of an optical interferometer operated in the single-fringe mode. The operation of the phase macroscope is treated theoretically, first heuristically and then by diffraction integrals. Conditions for optimum imaging are derived. The "phase plate" of Zernike is modified for use with focused laser illumination, and parameters for optimum imaging are given. Quite different mirrors are required for the full range of interesting plasmas accessible to the L.P.M. The experimental model is described. Phasograms of weak and strong shocks in air and argon down to .5 mm Hg pressure are shown. Rayleigh–Taylor instability behind the shock is observed. Gas jets of various refractivities are also used as test objects. Phasograms of vacuum sparks producing jets of ablated electrode material are shown. Many objects studied are invisible to Schlieren photography using the same illumination and optics. Author (TAB)

N66-33372*# Ohio State Univ., Columbus. Dept. of Physics.
OPTICAL MASER PHOTON RATE GYROSCOPE
C. V. Heer [1964] 12 p refs Presented at the Symp. on Unconventional Inertial Sensors, Farmingdale, N. Y., 19–20 Oct. 1964
(Grant NsG-552)
(NASA-CR-59820) CFSTI: HC $1.00/MF $0.50 CSCL 20E

The basic equations for the resonant frequencies of an electromagnetic cavity in an accelerated system of reference are considered. The removal of the degeneracy between clockwise and counter-clockwise resonant modes in vacuum is discussed in terms of the angular momentum of the photon. If matter with an index of refraction is placed in the cavity the shift in resonant frequency is shown to depend upon the moment of the energy flux. A maser media in the cavity permits oscillation and the beat frequency which is caused by rotation is discussed for a Fabry–Perot square cavity with all flat mirrors and which is oscillating at 3.39 microns. Saturation problems are considered. Author

N66-33411*# Ohio State Univ., Columbus. Dept. of Physics.
AN EVALUATION OF THE OPTICAL MASER PHOTON RATE GYROSCOPE
C. V. Heer [1964] 39 p refs Presented at the Colloq. on Advan. Gyroscopes, Paris, 2–6 Nov. 1964; sponsored by the Natl. Center of Spatial Studies
(Grant NsG-552)
(NASA-CR-59809) CFSTI: HC $2.00/MF $0.50 CSCL 20E

Calculations for a formal development of the resonant frequencies of an electromagnetic cavity in an accelerated frame of reference are presented to evolve a method of measuring the absolute rotation of a system with electromagnetic radiation. Equations of motion are used for single and degenerate modes and for calculating the polarization of an optical maser medium. The optical maser photon rate gyroscope is evaluated. Schematic designs of the photon rate gyroscope and other typical cavities are given, along with various curves obtained from equations occurring in the series of calculations. L.S.

N66-33524# Florence Univ. (Italy).
A GENERALIZATION OF TANG, STATZ AND DEMARS THEORY OF MULTIMODE OSCILLATION IN A SOLID-STATE LASER Interim Scientific Report No. 2
L. Ronchi Feb. 1966 32 p refs
(Contract AF 61(052)-871)
(AFCRL-66-384; AD-634913) CFSTI: HC $2.00/MF $0.50

The Tang, Statz and Demars theory of multimode oscillations of a solid-state laser, under stationary conditions, is extended to treat the cases of cavities with lossy end mirrors or with frequency-dependent losses. Author (TAB)

N66-33688*# National Aeronautics and Space Administration, Washington, D. C.
REVIEW OF THE PRESENT SITUATION ON LASER RESEARCH [UBERSICHT UBER DIE DERZEITIGE SITUATION AUF DEM LASERGEBIET]
E. David Jun. 1966 27 p refs Transl. into ENGLISH from Inst. Franco-Allemand de Rech. de Saint-Louis (France), Note Tech. T 21/63, 2 Oct. 1963
(NASA-TT-F-10201) CFSTI: HC $2.00/MF $0.50 CSCL 20E

A general review over the papers presented at the 1963 New York Symposium on Optical Masers is given, including theoretical background and future application of lasers. Laser materials, types of lasers (solid-state, gas, semiconductor, etc.), control of laser emission, types of modulation (internal and external), excitation methods, and practical applications are reviewed. The principle of continuous and spike emission is explained, without radically new interpretation. Author

N66-33813# General Precision, Inc., Pleasantville, N. Y. Aerospace Group.
PUMPED TRANSFORMER LASERS Technical Summary Report No. 3, 1 Nov. 1965–1 May 1966

C. B. Ellis, J. H. Simpson, D. S. Bayley, E. C. Eberlin, and I. A. Greenwood 25 May 1966 84 p refs
(Contract Nonr-4718(00); ARPA Order 306; Proj. Defender)
(GPL-A-31-3; AD-633839) CFSTI: HC $3.00/MF $0.75

Both experimentation and analysis are underway on the possible use of cesium vapor for a transformer laser to be optically pumped by a battery of Nd glass lasers. A number of important unknown parameters of the Cs_2 molecule have now been estimated, as a result of a detailed survey of existing data on the other alkali metal molecules. Experimentally, the absorption spectrum of saturated cesium vapor, contained in specially resistant glass at over 400°C, has been explored throughout the 1μ region at a dispersion of 21Å/mm. The fluorescent emission of the vapor in this region has also been studied, under irradiation with about 80 watts/cm^2 of 1.06μ Nd glass laser light. It seems reasonably clear that Cs_2 molecules which absorb Nd light are actually raised to the lower vibrational levels of the Cs_2 an electronic state, as planned. A bleaching of the Cs_2 absorption transitions at 1.06μ upon pumping with one Nd glass laser indicates some likelihood that around 50% of the Cs_2 molecules irradiated are being maintained in this excited state throughout a millisecond pulse. Fluorescence at wavelengths other than pumping wavelength indicates the presence of energy-exchanging molecular collisions, of the general type needed for achieving a high power transformer laser cycle. Author (TAB)

N66-33863*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
A NEW CLASS OF TRAPPED LIGHT FILAMENTS
E. Garmire, R. Y. Chiao, M. A. Johnson, S. Krinsky, H. A. Smith (MIT) et al [1966] 25 p refs
(Grant NsG-330; Contract AF 19(628)-4011)
(NASA-TM-X-57831) CFSTI: HC $1.00/MF $0.50 CSCL 20E

It is shown that the Raman radiation stimulated by self-trapped filaments of light in intense laser beams is characteristically associated with a new class of filaments of much smaller diameter than the previously identified 50 μ. These new filaments also have different threshold properties, and their characteristics affect substantially the nature of the Stokes and anti-Stokes radiation. A Q-switched ruby laser with a 50 cm cell of carbon disulfide was used, and a beam from a 0.5 mm pinhole provided the exciting light. An Airy disk and an Airy ring of the Fraunhofer diffraction from the pinhole formed the background light. Reflections from a partially reflecting mirror in the laser beam inside a liquid cell were used to show the persistence of these small-scale filaments for many centimeters. The mirror consisted of a dielectrically coated six-micron-thick mylar film. Photomicrographs of the emerging beam were taken and analyzed. The effect of these small-scale trappings on stimulated radiation and on phase velocity, refraction index, acoustic velocity, radiation frequency, and radiation intensity is pointed out in conclusion. K.W.

N66-34015# Bausch and Lomb, Inc., Rochester, N. Y.
LASER DAMAGE STUDY OF THIN FILMS Final Technical Report, 1 Apr. 1965-1 Apr. 1966
J. Becker, W. F. Coombs, and A. F. Turner [1966] 82 p refs
(Contract Nonr-4717(00); ARPA Order 306)
(AD-633564) CFSTI: HC $3.00/MF $0.75

Damage to optical surfaces and materials is often experienced in high intensity laser beams. The threshold values above which this damage occurs are of interest for both optical engineering and theoretical purposes. In the present work energy density thresholds were determined for single quarter-wave and halfwave films vacuum evaporated on glass and quartz substrates. Using a 6 μsec ruby laser pulse films of the following dielectric materials were studied: ThF_4, MgF_2, Al_2O_3, 5NaF. $3AlF_3$, SiO_2, ZrO_2, TiO_2, CeO_2, and ZnS. Aluminum and inconel films were also included. The latter were found to have thresholds around .05 joules/sq cm, whereas thresholds for the dielectrics covered the range from 50 down to 0.5 J/sq cm, roughly in the sequence of the preceding listing. Author

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N66-32795*# National Research Corp., Cambridge, Mass. Norton Exploratory Research Div.
A STUDY OF THE ADHESION AND COHESION OF METALS Fourth Quarterly Progress Report, 9 Mar.-9 Jun. 1966
M. J. Hordon Jun. 1966 16 p
(Contract NASw-1168)
(NASA-CR-76920) CFSTI: HC $1.00/MF $0.50 CSCL 11F

Modifications and improvements to the test apparatus were made including the redesign of the refrigeration and cooling system and the specimen selector and abrader mechanisms. The modified apparatus components were installed and preliminary vacuum pumping operations were begun. Selected specimens with various lattice structures were prepared for adhesion testing. Heat treatment procedures to produce nearly equivalent yield strengths were carried out. Author

N66-32805*# Syracuse Univ. Research Inst., N. Y. Dept. of Chemical Engineering and Metallurgy.
ADHESION BETWEEN ATOMICALLY PURE METALLIC SURFACES, PART IV Semiannual Report
D. V. Keller, Jr., K. Johnson, and W. Saunders Jul. 1966 48 p refs
(Grant NsG-483-1)
(NASA-CR-76865; MET-1100-667SA) CFSTI: HC $2.00/MF $0.50 CSCL 11F

The theoretical basis for adhesion between metals under ultrahigh vacuum conditions is examined to identify inhibition mechanisms, and the results of contact resistance experiments are applied to the interpretation of metallic adhesion data. Only contamination appears as an adhesion barrier in metal couples made from silver-silver, copper-nickel, and silver-nickel. Contact resistance measurements provide a qualitative method for the interpretation of boundary conditions during adhesion testing. The relationship of contact resistance measurements before and after rigorous argon ion cleaning of silver-silver couples is discussed, and graphs of contact resistance versus contact force are given. An experiment is described which studied the effects of hexagonal crystal structure and surface contamination on adhesion between tungsten, molybdenum, and titanium couples. The results showed that the atomic structure of metals was no criterion for adhesion. There was a considerable reduction in the contact resistance of the titanium, molybdenum, and tungsten couples after surface cleaning, together with indications of bonding in the titanium and molybdenum couples at heavier loads. E.A.O.

N66-32808# European Atomic Energy Community, Brussels (Belgium).
DEFORMATION MECHANISMS IN HEXAGONAL COMPACT METALS [MECANISMES DE DEFORMATION DES METAUX A STRUCTURE HEXAGONALE COMPACTE]
P. Guyot 1965 34 p refs In FRENCH
(EUR-2621.f)

A review is presented on the deformation mechanisms in the hcp metals. Only the basal glide, controlled by cutting the forest of dislocations c, is well understood; the prismatic gilde seems to be determined by the cross slip of basal screw dislocations. The increase of dislocations as well as twinning the basal easy glide are also considered. (79 references).
Author (NSA)

N66-32814# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
THE STRESS-RELAXATION BEHAVIOR OF 85-15 HAFNIUM BETWEEN 700 AND 1700°F
P. T. Lovejoy and E. E. Baldwin Apr. 1966 27 p refs
(Contract W-31-109-ENG-52)
(KAPL-3120) CFSTI: HC $2.00/MF $0.50

The stress-relaxation properties of Hf were investigated between 700 and 1700°F in the longitudinal and transverse orientations. The transverse orientation is limiting, retaining a higher stress than the longitudinal orientation. A conclusion reached in a previous investigation—that 3 hr at 1200°F reduces the maximum residual stress below 5000 psi—was substantiated. An activation energy for stress-relaxation of 74,000 cal/mole in the longitudinal direction was determined. The activation energy in the transverse direction is higher. No characteristic value was determined in the transverse orientation. Incomplete stress-relief annealing of plastically deformed Hf did not result in measurable distortions. Stress-relief annealing of typical Zircaloy welds show that electron-beam welds distort less than do TIG welds, and TIG butt welds distort less than do TIG vee welds. Author (NSA)

N66-32815# California Univ., Berkeley. Lawrence Radiation Lab.
THE VISCOSITY OF LIQUID METALS
Thomas W. Chapman 15 Feb. 1965 29 p refs
(Contract W-7405-ENG-48)
(UCRL-11930) CFSTI: HC $2.00/MF $0.50

An approximate form is suggested for the perturbation of the radial distribution function of a monatomic liquid by a nonuniform flow field. Substitution of this form into the microscopic expression for the pressure tensor yields an equation for liquid viscosity in terms of the equilibrium distribution function and the interatomic potential energy function. This equation establishes the basis for a corresponding states correlations of the viscosity of liquid metals based on atomic parameters. The viscosity data for twenty-one molten metals are made to fall on a single curve by the adjustment of one microscopic parameter. It was found that this empirically determined parameter apparently has the proper fundamental significance. Therefore, it is possible to estimate it independently and to use the general correlation for estimating the viscosity of a metal for which data are not available. It is also suggested that the atomic parameters determined might be used to correlate other properties of the liquid metals.
Author (NSA)

N66-32826# Battelle Memorial Inst., Geneva (Switzerland).
ON THE THEORY OF NOTCH-BRITTLENESS IN STEELS OCCURRING DURING TIME-TO-RUPTURE TESTS
W. Siegfried 26 Apr. 1965 78 p refs Presented at the Natl. Meeting of ASME, Berkeley, Calif., 9–11 Jun. 1965
(Contract EURATOM-100-62-12 RDS)
(EURAEC-1350; EUR-2325.e; Conf-650607-2) CFSTI: HC $3.00/MF $0.75

The present experimental results are not sufficient to allow an exhaustive explanation of the embrittlement mechanism. The difference between the time-to-rupture curves for unnotched and notched bars can primarily be explained by the interaction of three effects: relaxation of the stress peak with time, formation and propagation of fissures in the material, and inhibition of plastic deformation owing to the formation of a tridimensional state of stress. Author (NSA)

N66-32827# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
PRODUCTION AND PROPERTIES OF SINTERED URANIUM [OTRZMYWANIE I WLASNOSCI SPIEKANEGO URANU]
A. Hofman Dec. 1965 16 p refs In POLISH; ENGLISH summary
(INR-666/14/PS)

Uranium powder was obtained by decomposing uranium hydride, UH_3. Properties of the powder were investigated, and the density of sintered uranium powder dependence on pressure and sintering temperature was defined. The metallographic investigation of sintered uranium powder is described.
Author (NSA)

N66-32828# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
THE INITIAL FORMATION AND GROWTH OF INTERMETALLIC PHASES IN Cu-Zn SYSTEM [TWORZENIE I WZROST FAZ MIEDZYMETALICZNYCH W UKLADZIE Cu-Zn]
H. Matyja and St. Gabrycki 1965 18 p refs In POLISH; ENGLISH summary
(INR-643/14/PB)

The growth rate of single intermetallic α, β, and ϵ phases of the Cu–Zn system was studied, and the parabolic growth rate law was observed. Activation energies for the growth of single intermetallic phases were calculated. Author (NSA)

N66-32830# Joint Publications Research Service, Washington, D. C.
RHENIUM ALLOYS
E. M. Savitskii, M. A. Tylkina, and K. B. Povarova 15 Mar. 1966 217 p refs Transl. into ENGLISH from the Book "Splavy Reniya" Moscow, Nauka Publishing House, 1965 p 26–31; 168–235; 255–331
(JPRS-34566; TT-66-31006) CFSTI: HC $6.00/MF $1.25

Selected chapters of the Russian-language book on Re and Re alloys were translated. The translated chapters cover the following topics: consolidation, preparation and treatment of the alloys, mechanical properties, weldability, elastic properties, heat expansion, uses in electronics and electrical engineering, uses in thermocouples, uses as electric contacts, chemical heat treatment, coatings, corrosion resistance, and catalytic properties. NSA

N66-32842# Bettis Atomic Power Lab., Pittsburgh, Pa.
THE CORROSION AND HYDROGEN PICKUP OF ELECTRON BEAM WELDED NICKEL-FREE ZIRCALOY-2 AND ZIRCALOY-4
S. Kass Mar. 1966 22 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-533) CFSTI: HC $1.00/MF $0.50

Corrosion tests with Zircaloy-4 and nickel-free Zircaloy-2 exhibiting large alpha grains formed by electron beam welding and annealing at 1450°F revealed that the large grain material does not corrode at rates significantly different from finer grained material, nor does the large grain material exhibit greater tendencies to absorb hydrogen than the finer grain materials. Author (NSA)

N66-32843# Bettis Atomic Power Lab., Pittsburgh, Pa.
THE EFFECT OF SILICON ON THE CORROSION AND HYDROGEN ABSORPTION CHARACTERISTICS OF ZIRCALOY-4 AND NICKEL-FREE ZIRCALOY-2
S. Kass Apr. 1966 21 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-544) CFSTI: HC $1.00/MF $0.50

The corrosion and hydrogen absorption chrarcteristics of Zircaloy-2, Zircaloy-4, and nickel-free Zircaloy-2 containing added quantities of silicon were determined. Silicon additions caused no significant alterations in the 680°F corrosion resistance, but produced marked reductions in the tendencies for the alloys to absorb hydrogen during corrosion exposure. The hydrogen absorption characteristics were found to be dependent upon silicon contact and prior thermal treatment. Author (NSA)

N66-32844# Atomic Weapons Research Establishment, Aldermaston (England).
THE PERMEATION AND DIFFUSION OF HYDROGEN ISOTOPES THROUGH STEELS. PART 3: MARAGING STEEL
P. M. S. Jones, R. Gibson, and J. A. Evans Apr. 1966 22 p refs
(AWRE-O-19/66) HMSO: 5s 6d

Studies were made on the permeability, diffusion, and solubility of deuterium and hydrogen in maraging steel. The results obtained were: $P_{H_2} = 0.093 \exp{-(11100/RT)}$std ml $cm^{-2}\,s^{-1}\,atm^{-0.5}$ mm, and $D_{H_2} = 2.46 \exp{-(12700/RT)}cm^2\,s^{-1}$. The deuterium isotope effect on diffusion was small but the permeation rate fell by a factor of 1.25. It was also found that hydrogen dissolves exothermically in maraging steel. NSA

N66-32845# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
CONTRIBUTION TO THE STUDY URANIUM-CARBON-OXYGEN [CONTRIBUTION A L'ETUDE DU SYSTEME URANIUM-CARBONE-OXYGENE]
Jean-Pierre Morlevat (Ph.D. Thesis—Grenoble Univ.) 1966 59 p refs In FRENCH
(CEA-R-2857)

The region U–UC–UO_2 of the U–C–O diagram was investigated by the saturation method. This system is of the ternary eutectic type, the eutectic point lying close to pure uranium. The UO_2–UC plane can be considered as pseudo-binary; it involves a eutectic UO_2–U (C,O) melting at about 2250° C. The oxicarbides U (C,O) percipitated from the melt can be considered as stoichiometric (C + O/U = 1), with a formula close to $UC_{0.65}O_{0.35}$ for deposition temperature below 2200° C. Author (NSA)

N66-32858# MSA Research Corp., Evans City, Pa.
EFFECT OF HIGH TEMPERATURE SODIUM ON AUSTENITIC AND FERRITIC STEELS. MECHANICAL PROPERTIES OF MATERIALS Quarterly Progress Report, Jan.–Mar. 1966
R. C. Andrews and K. R. Barker 25 Apr. 1966 29 p ref
(Contract AT(11-1)-765)
(MSAR-66-71) CFSTI: HC $2.00/MF $0.50

The results of studies on effects of sodium on austenitic and ferritic stainless steel at high temperature, cold trap analyses, and testing of LVDT's (Linear Variable Differential Transformers) for extensometer development are reported. Creep-rupture specimens in sodium environment exhibited a change in fracture mode between short (<400 hr) and long (>1000 hr) time failures. Helium fatigue specimens showed a different type of corrosion product than was found in stainless steel 316 tests. The liquid metal extensometer system is illustrated. The most expedient method found for cold trap analyses was to drive sampling tubes into the contents. The design of the sampling tube is illustrated. NSA)

N66-32870# Commissariat a l'Energie Atomique, Saclay (France). Service Central de Documentation.
BIBLIOGRAPHY ON APPLICATIONS OF ELECTRON BEAM TECHNIQUES IN METALLURGY [LES APPLICATIONS METALLURGIQUES DU BOMBARDEMENT ELECTRONIQUE]
Marie-Genevieve le Levier Apr. 1966 54 p refs In FRENCH
(CEA-BIB-43)

References (259) are given to journals and reports published from 1960 through 1965. Separate author and subject indexes are included. NSA

N66-32872# Bettis Atomic Power Lab., Pittsburgh, Pa.
THE EFFECTS OF HEAT TREATMENT ON THE CORROSION AND HYDROGEN ABSORPTION CHARACTERISTICS OF A ZIRCONIUM-NIOBIUM-COPPER (ZR + 2.5% Nb + 0.5% Cu) ALLOY
S. Kass Mar. 1966 27 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-500) CFSTI: HC $2.00/MF $0.50

Corrosion tests in 600° and 680°F water and in high pressure steam at 750° and 950°F revealed that the Zr–2.5% Nb–0.5% Cu alloy possesses favorable corrosion characteristics. Optimum properties were obtained when the alloy was quenched from the alpha-plus-beta region and subsequently aged in the alpha region. Author (NSA)

N66-32888# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
TENSILE DEFORMATIONS IN MONOCRYSTALLINE AND POLYCRYSTALLINE URANIUM BETWEEN 20 AND −196°C
Andre Lemogne (Ph.D. Thesis) 1966 78 p refs In FRENCH
(CEA-R-2819)

Tensile stress tests were carried out at low temperatures (between 20 and −196°C) on monocrystalline and polycrystalline uranium of various purities. The mechanical properties of the monocrystals were related, at all temperatures, to plastic flow mechanisms. Below −1000° C brittle fracture occurs on the plane making up the twins. A detailed study of the plastic behavior at −196°C made it possible to show that all the twin planes except {176} were liable to become privileged planes for brittle fracture. The mechanical properties of the polycrystals, the breaking stress, and elongation at breaking point, decreased as the temperature decreased from 20 to −196° C. It was verified that Petch's law is approximately applicable to the plastic flow and rupture stresses; a study was also made of the influence of temperature and purity on the constants occurring in this equation. Finally, experiments at −196°C on the deformation up to breaking point of polycrystalline samples cold-worked at 20°C showed the importance of the role played by intergranular cracks in the plastic behavior of uranium. Author (NSA)

N66-32889# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.

STAINLESS STEEL FAILURE INVESTIGATION PROGRAM

Quarterly Progress Report No. 3, Oct. 1–Dec. 31, 1965

R. N. Duncan, comp. Feb. 1966 40 p refs

(Contract AT(04-3)-189)

(GEAP-5085; EURAEC-1599) CFSTI: HC $2.00/MF $0.50

Corrosion tests on type 304 stainless steel in HNO_3-Cr^{6+} to determine the effect of high gamma radiation fields (~1,000 R) indicate that the presence of high energy gamma radiation does not increase the dissolution rate of the stainless steel. Results of 24 hr corrosion tests obtained previously on irradiated and unirradiated type 304 stainless steel in boiling HNO_3-Cr^{6+} are valid and indicate that irradiation exposure increases susceptibility to corrosion. The weight loss of irradiated cladding samples was consistently higher than that of unirradiated control specimens by a factor of two. Microthermoelectric measurements across grain boundaries in nonirradiated and irradiated stainless steel were completed and indicate no significant difference between the thermoelectric properties of grains and grain boundaries. A portable autoclave system was assembled and tested in preparation for corrosion tests on irradiated type 304 stainless steel samples in 650°F, 0.1 g/l iron chloride solutions. The various irradiated samples for these tests were prepared. Electrochemical studies at elevated temperatures, up to 275°C were initiated. Potentiostatic and intensiostatic curves were obtained for type 304 stainless steel samples in deionized water and in dilute iron chloride solutions. Variations due to scan speed, temperature and different electrolytes were observed. Author (NSA)

N66-32986# Joint Publications Research Service, Washington, D. C.

MECHANICAL AND ENGINEERING PROPERTIES OF TITANIUM ALLOYS

I. I. Kornilov and N. G. Boriskina, ed. 26 Jul. 1966 235 p refs Transl. into ENGLISH of Articles from Novyye Issled. Splavov, Pt. III (Moscow), 1965 p 167–333

(JPRS-36680; TT-66-33111) CFSTI: $6.00

Articles on mechanical, thermal, chemical, and physical properties of titanium and titanium alloys are presented. For individual titles see N66-32987–N66-33012.

N66-32987# Joint Publications Research Service, Washington, D. C.

SPECIAL FEATURES OF PLASTIC FLOW AND FAILURE OF TITANIUM AT ROOM TEMPERATURE

I. A. Oding, V. S. Ivanova, and Ye. S. Kosyakina *In its* Mech. and Eng. Properties of Titanium Alloys 26 Jul. 1966 p 1–8 refs (See N66-32986 19-17) CFSTI: $6.00

Special features in the development of plastic flow and failure of titanium at room temperature are considered which distinguish it from other metals, including those with hexagonal close-packed lattice. High sensitivity to stress concentration and state of the surface is exhibited by titanium and its alloys, and high corrosion resistance is noted. Alpha-titanium is distinguishable from other hexagonal metals by a higher plasticity than would be expected by a metal with a CP-lattice. X-ray investigation reveals that the planes of the pyramid and prism of titanium are activated for slip at room temperature; and the high plasticity of titanium at room temperature is explained by the presence of several equiprobable sliding systems and several possible systems of twinning planes. These and other data indicate the complexity of realizing plastic flow when using statistical loads on the crystals of pure titanium. An electron microscope study of the plastic flow mechanism in a titanium alloy with sign variable bending shows that deformation takes place in various ways due to cyclical loading. The most probable mechanism for formation of the fault band in hexagonal metals is considered to be a dislocation. M.W.R.

N66-32988# Joint Publications Research Service, Washington, D. C.

THE PROBLEM OF ELASTICITY MODULUS OF METALS AND TITANIUM ALLOYS

R. A. Ul'yanov and S. F. Kovtun *In its* Mech. and Eng. Properties of Titanium Alloys 26 Jul. 1966 p 9–17 refs (See N66-32986 19-17) CFSTI: $6.00

Melting point, thermal expansion coefficient, and elasticity modulus are presented as functions of total number of (d+s)-electrons for elements of the three long periods. Maximum elasticity modulus is achieved in elements with 8(d+s)-electrons; highest melting point and lowest thermal expansion coefficient with 6(d+s)-electrons. Laws of variation for elasticity moduli are discussed for metals and their alloys. An increase in elasticity modulus is noted when alloying molybdenum with rhenium, and nickel with chromium. When there is no difference in the atomic numbers and number of electrons between the base and alloying alloys, the elasticity modulus for the resultant alloy does not change since there is no change in electron concentration and little change in crystal lattice. The elasticity modulus of molybdenum does not change when it is alloyed with up to 30% tungsten. M.W.R.

N66-32989# Joint Publications Research Service, Washington, D. C.

THE INFLUENCE OF ALLOYING ON THE YOUNG'S MODULUS, STRENGTH AND PLASTICITY OF TITANIUM IN THE TEMPERATURE RANGE FROM –196 TO 800°

S. F. Kovtun and R. A. Ul'yanov *In its* Mech. and Eng. Properties of Titanium Alloys 26 Jul. 1966 p 18–28 refs (See N66-32986 19-17) CFSTI: $6.00

An increase in elasticity modulus is obtained when titanium is alloyed at temperatures between –196 to 800°C with aluminum, chromium, molybdenum, palladium, and rhenium below the limits of solubility in alpha-titanium. When concentration of these metals exceeds solubility in alpha-titanium, the Young's modulus of the alloys is less than that for pure titanium. An increase in temperature does not lower the Young's modulus as much. In concentrations up to 3%, rhenium increases alloy strength but sharply lowers plasticity; whereas palladium and tantalum have insignificant influence on the strength and plasticity of titanium alloys. Alloying of lanthanum within the limits of solubility in alpha-titanium has little effect on strength but increases plasticity at low temperatures. High plasticity of titanium alloys can be maintained at low temperatures and impurities are removed by use of a vacuum process. M.W.R.

N66-32990# Joint Publications Research Service, Washington, D. C.

THE PHYSICAL PROPERTIES OF BINARY ALLOYS OF TITANIUM IN THE QUENCH-HARDENED STATE

S. G. Fedotov, K. M. Konstantinov, and Ye. P. Sinodova *In its* Mech. and Eng. Properties of Titanium Alloys 26 Jul. 1966 p 29–39 refs (See N66-32986 19-17) CFSTI: $6.00

Concentration dependency of the elastic and electrical properties of titanium alloys hardened in the β-region are investigated in alloys with molybdenum, niobium, and vanadium as well as those with chromium, cobalt, iron, manganese, and nickel. Extremal values of the elastic properties of the

latter group are shown to be higher. For both groups it is shown that the properties are sensitive to the structure of the hardened alloys. The appearance in the structure of the ω-phase corresponds to a decrease in specific electrical resistance and an increase in normal resistance and shift modulus. Self-tempering of the supersaturated α'-solutions, which occurs in systems with eutectic decomposition, increases with increasing temperature and is reflected in the values of plastic properties. M.W.R.

N66-32991# Joint Publications Research Service, Washington, D. C.

THE CHANGE IN STRUCTURE AND PROPERTIES OF $(\alpha+\beta)$-TITANIUM ALLOYS DEPENDING ON HEAT TREATMENT

V. N. Moiseyev and L. V. Geras'kova *In its* Mech. and Eng. Properties of Titanium Alloys 26 Jul. 1966 p 40-49 refs (See N66-32986 19-17) CFSTI: $6.00

Variations in structure and properties of three industrial titanium alloys with $(\alpha+\beta)$-structure are related to heat treatment. Highest strength is obtained in the alloy which is hardened at temperatures close to the polymorphic conversion where there is a maximum amount of α'-phase. When the alloy is hardened in water at temperatures greater than 800°C, the martensitic α''-phase is formed which has lower strength and higher plasticity. The maximum strength for another alloy specimen hardened to the β-phase is achieved after aging for four hours at 400° and for 16 and 64 hours at 350°C. The alloy hardened to the α''-phase reaching maximum strength after aging for 64 hours at 400°, 16 hours at 450°, or four hours at 500°C. Hardening and aging to the α''-phase will be retained at higher temperatures than for the β-phase. Limited study of the ω-phase has been made, but it is known that this formation is accompanied by some increase in stability and a sharp decrease in plasticity. M.W.R.

N66-32992# Joint Publications Research Service, Washington, D. C.

THE INFLUENCE OF HEAT TREATMENT ON THE PROPERTIES, STRUCTURE AND PHASE COMPOSITION OF THE ALLOY VT3-1

O. P. Solonina *In its* Mech. and Eng. Properties of Titanium Alloys 26 Jul. 1966 p 50-57 (See N66-32986 19-17) CFSTI: $6.00

Three different levels of strength can be obtained in a martensitic titanium alloy depending on heat treatment employed. High strength properties, 15 to 30% higher as compared to that obtained by isothermic annealing, along with satisfactory plasticity and thermal stability is obtained by water hardening at 880 ±10°C and aging for five to 10 hours 550 ±10°C. Maximum plastic properties and thermal stability with minimum strength are obtained by isothermal annealing at a lower temperature and cooling in air. It is indicated that basic changes in the structure and properties of this alloy result from decomposition while aging. The initial microstructure obtained after deformation has a significant effect on plasticity. M.W.R.

N66-32993# Joint Publications Research Service, Washington, D. C.

SOME GENERAL LAWS OF THE OCCURRENCE OF HYDROGEN BRITTLENESS IN THE ALLOYS VT3-1 AND VT15

B. A. Kolachev, V. A. Livanov, N. Ya. Gusel'nikov, and A. A. Bukhanova *In its* Mech. and Eng. Properties of Titanium Alloys 26 Jul. 1966 p 58-69 refs (See N66-32986 19-17) CFSTI: $6.00

Consideration is given to hydrogen brittleness which occurs in titanium alloys at low rates of plastic flow, and for an $(\alpha+\beta)$-titanium alloy this brittleness is more intense at low deformation rates and below room temperatures; for a β-titanium alloy brittleness is also observed at low deformation rates and over a temperature range of from −30 to +10°C. It is processes that occur in the β-phase that make for the hydrogen brittleness in the $(\alpha+\beta)$-titanium alloys. Brittleness is attributed to dissociation and based on the assumption that hydrogen forms in the Cottrell atmospheres to form dislocations. Dislocations transport the hydrogen to grain boundaries, resulting in crack formation. Plastic deformation of the metal at the head of the crack, thereby, becomes impossible. M.W.R.

N66-32994# Joint Publications Research Service, Washington, D. C.

THE INVESTIGATION OF HEAT RESISTANCE OF THE TITANIUM ALLOY AT3 AFTER ORDINARY AND MECHANICAL-THERMAL TREATMENT

I. I. Kornilov, V. S. Ivanova, K. P. Markovich, and Z. G. Fridman *In its* Mech. and Eng. Properties of Titanium Alloys 26 Jul. 1966 p 70-78 refs (See N66-32986 19-17) CFSTI: $6.00

Heat-resistant properties are studied for a titanium alloy which contains 2.7% aluminum, 0.6% chromium, 0.36% silicon, 0.3% iron, and 0.01% boron. The alloy was subjected to heating at 880°C, holding for 30 minutes, and cooling in air. Creep rate varies very little at 350°C with variation in stress and stress-rupture strength is very high. High stability of the structural state and absence of embrittlement are noted during the creep process. These observations as well as low oxidizability and high plasticity make the alloy a candidate for structural materials for long-term use at temperatures of 350 to 400°C. At higher temperatures some instability is reported. Mechanical-thermal processing is used to obtain more even distribution of metalloids in the alloy; and is, therefore, recommended for increasing the lifetime of titanium alloys. M.W.R.

N66-32995# Joint Publications Research Service, Washington, D. C.

SOME MECHANICAL AND PHYSICAL PROPERTIES OF ALLOYS OF THE SYSTEM Ti-Cr-Fe

I. I. Kornilov and N. G. Boriskina *In its* Mech. and Eng. Properties of Titanium Alloys 26 Jul. 1966 p 79-90 refs (See N66-32986 19-17) CFSTI: $6.00

Decomposition and phase structure determine the mechanical characteristics of titanium alloys containing chromium and iron which are subjected to hardening at 750°C and annealing at 400°C. Iron and chromium increase alloy strength; and the best combination of ultimate strength and elongation is found in alloys with 7.5 to 12.5% iron and chromium combined content hardened at 750°C with a structure of $(\alpha+\beta)$-solid solutions. Heat resistance and specified electrical resistance is also increased by the iron and chromium. Young's modulus in annealed alloys is increased by a combined iron-chromium content of between one and 12.5%. M.W.R.

N66-32996# Joint Publications Research Service, Washington, D. C.

THE INFLUENCE OF HEAT TREATMENT ON THE MECHANICAL PROPERTIES OF ALLOYS OF THE AT2 TYPE

I. I. Kornilov, V. A. Livanov, O. K. Belousov, S. M. Faynbron, V. S. Mikheyev et al *In its* Mech. and Eng. Properties of Titanium Alloys 26 Jul. 1966 p 91-96 refs (See N66-32986 19-17) CFSTI: $6.00

Titanium alloys containing various quantities of zirconium, vanadium, niobium, and/or molybdenum have been studied to determine the influence of heat treatment on their mechanical properties. It is shown that at annealing temperatures up to 700°C, there is practically no change in ultimate strength and yield point. Plasticity and impact viscosity are also increased as compared to what occurs following forging of the alloys. Strength characteristics decrease with an increase in annealing temperature. The best combination of mechanical properties for an alloy designated AT2-1 is obtained by annealing at 500 to 600°C, with holding for 30 to 60 minutes, and cooling in water; a temperature of 600°C is recommended for the alloy designated AT2-2. M.W.R.

N66-32997# Joint Publications Research Service, Washington, D. C.

SOME MECHANICAL AND PHYSICAL PROPERTIES OF THE ALLOY AT13

I. I. Kornilov, K. I. Shakhova, P. A. Nuss, B. A. Klimov, P. B. Budberg et al *In its* Mech. and Eng. Properties of Titanium Alloys 26 Jul. 1966 p 97–101 refs (See N66-32986 19-17) CFSTI: $6.00

An eight-component high test weldable titanium alloy was developed which has an ultimate strength up to 130 kg/mm^2 and satisfactory plasticity. A titanium sponge, aluminum, zirconium iodide, and 99.9% pure molybdenum were used in the main preparation; and chromium, iron, silicon, and boron were introduced as corresponding master alloys. Dual remelting of the ingot was accomplished in an electric arc vacuum furnace with a water-cooled copper crystallizer; and heating in an ordinary furnace with an air atmosphere was accompanied by forging and rolling. Heating temperature while forging was between 1050 and 1100°C, while the temperature at the end of forging was 600° C. The alloy which can be made into sheets and bars as well as forgings, has a structure that is almost entirely α-phase. Ultimate strength of the alloy, designated AT13, is 127 to 129 kg/mm^2, yield point is between 120 and 125 kg/mm^2, impact viscosity is 3 kgm/cm^2, and Vickers hardness is 258 kg/mm^2. Elongation per unit length is between 4 and 6%, and reduction in the area of transverse cross section is 30 to 35%. M.W.R.

N66-32998# Joint Publications Research Service, Washington, D. C.

THE INVESTIGATION OF STRENGTH OF TITANIUM ALLOYS BY THE BEND METHOD AT 600°

I. I. Kornilov, T. T. Nartova, and O. N. Andreyev *In its* Mech. and Eng. Properties of Titanium Alloys 26 Jul. 1966 p 102–106 refs (See N66-32986 19-17) CFSTI: $6.00

Mechanical properties and heat resistance of titanium alloys containing between 6 and 6.5% aluminum were investigated. To increase homogeneity, the alloy ingots were remelted three times in an electric arc furnace with a nonconsumable tungsten electrode in an atmosphere of pure helium. Heat resistance is found to increase along with increased complication of the composition of the α-solid solution; and among the alloys studied, the highest resistance to heat was found for an alloy of the quaternary system Ti–Al–Zr–Sn. Alloys containing both the alpha and beta structure exhibit high creep and are not heat resistant at 600°C. The centrifuge method was found to be a satisfactory means of determining comparative heat resistances. M.W.R.

N66-32999# Joint Publications Research Service, Washington, D. C.

MECHANICAL AND HEAT RESISTANT PROPERTIES OF THE TITANIUM ALLOY ST1 AS A FUNCTION OF HEAT TREATMENT

V. A. Livanov, T. T. Nartova, S. M. Faynbron, R. M. Ryabova, and Z. G. Fridman *In its* Mech. and Eng. Properties of Titanium Alloys 26 Jul. 1966 p 107–115 refs (See N66-32986 19-17) CFSTI: $6.00

Mechanical and heat resistant properties are reported for a titanium alloy with varying amounts of aluminum and tin (ST1). Optimal plasticity conditions for ST1N (with low Al–Sn content) are obtained by annealing at 800°C and cooling in air; for ST1V (with high Al–Sn content) hardening in water from 1000°C is best. Both alloy forms exhibit high stress-rupture resistance up to 600 or 700°C. For ST1N, short-term ultimate strength at 700°C is 43 to 50 kg/mm^2, for ST1V it is between 53 and 70 kg/mm^2. The alloy ST1N exhibits highest resistance to creep at 750°C following heating at 1050 to 1150°C, holding for one hour, and cooling in air or water. Both forms of the alloy are recommended for prolonged operation at temperatures between 600 and 700°C, and for temporary service at 800°C. M.W.R.

N66-33000# Joint Publications Research Service, Washington, D. C.

THE INVESTIGATION OF WELDED JOINTS OF THE ALLOY VT15

L. A. Gruzdeva and M. A. Folomeyeva *In its* Mech. and Eng. Properties of Titanium Alloys 26 Jul. 1966 p 116–121 ref (See N66-32986 19-17) CFSTI: $6.00

Work hardening heat treatment leads to a sharp decrease in plasticity of the metal in the welded joints of a titanium alloy (VT15), and aging in the metal of the seam begins earlier than in the basic metal. Microstructure analysis indicates that the low plasticity of the aged welds can be explained by the intercrystalline vacancies from crystallization of the weld. Welding of clad sheets, welding with Al and Mo additives, high temperature hardening, and deformation of the weld were used to increase plasticity and strength of the titanium weld. Deformation of the weld with subsequent hardening and aging is found to increase strength and other mechanical properties. M.W.R.

N66-33001# Joint Publications Research Service, Washington, D. C.

THE INFLUENCE OF SMALL ADDITIONS OF BORON, BERYLLIUM AND LANTHANUM ON THE PROPERTIES OF WELDED JOINTS OF TITANIUM ALLOYS

Ye. A. Borisova, L. A. Gruzdeva, M. A. Folomeyeva, and I. I. Shashenkova *In its* Mech. and Eng. Properties of Titanium Alloys 26 Jul. 1966 p 122–128 refs (See N66-32986 19-17) CFSTI: $6.00

Beryllium, boron, and lanthanum were introduced in small quantities in the form of a master alloy into various titanium alloys to study effect on mechanical properties in welded joints. Additions of Be up to 0.04%, boron to 0.12%, and lanthanum to 0.10% have no effect on a technical titanium alloy at temperatures between 20 and 500°C. The alloying of two titanium alloys (OT4 and VT5) with Be results in some increase in ultimate strength of welded joints at room and higher temperatures, and plasticity is retained. The introduction of 0.13% B into OT4 and VT5 has a moderating effect on the welded joint, but decreases plasticity and insignificantly increases strength. M.W.R.

N66-33002# Joint Publications Research Service, Washington, D. C.

PHASE TRANSFORMATIONS AND THE CHARACTERISTICS OF WELDABILITY OF α-ALLOYS AND (α+β)-ALLOYS

M. Kh. Shorshorov and B. A. Smirnov *In its* Mech. and Eng. Properties of Titanium Alloys 26 Jul. 1966 p 129–140 refs (See N66-32986 19-17) CFSTI: $6.00

A general review is presented of kinetic phase transformations and changes in mechanical properties of various ti-

tanium alloy systems subjected to welding. Special consideration is given to phase transformations which result from conditions of continuous cooling, as well as to the influence of titanium alloy composition and thermal cycling parameters during welding on the structure and properties of welded joints. Three types of alloys are discussed: (1) technical titanium alloys, with α-phases containing Al and Sn as well as $(\alpha+\beta)$-phase with β-stabilizers up to the limit of their solubility in the α-phase; (2) combined phase alloys with a higher content of β-stabilizers; and (3) alloys with a high β-phase content. It is concluded that welding must be accomplished under very rigid conditions for all three types of alloys. Anisothermic transformation of titanium alloys that occur in the zone of complete recrystallization during welding are illustrated; along with anisothermic conversion, polymorphic and hydride transformations as related to hydrogen concentration, and mechanical properties in the weld-affected zone related to temperature. M.W.R.

N66-33003# Joint Publications Research Service, Washington, D. C.

DELAYED FAILURE OF TITANIUM ALLOYS

M. Kh. Shorshorov and V. N. Meshcheryakov *In its* Mech. and Eng. Properties of Titanium Alloys 26 Jul. 1966 p 141–155 refs (See N66-32986 19-17) CFSTI: $6.00

Samples of titanium alloys were subjected to constant stretching load at room temperature and plastic flow measurements during holding until failure in order to explain the mechanism of delayed failure. For failure of the metal in the weld-affected zone, the samples were melted with an argon-arc lamp and a tungsten electrode from each side of a notch which created a biaxial stress state and fixed the location of failure. In alloys with low and average yield points and with low content of gases (O_2, N_2, and H_2), a significant intragranular deformation is developed during testing. For alloys with a high yield point, the macroscopic deformation in the weld-affected zone is either very small or undetected. Differences in the nature of cracks in the titanium alloys is discussed, and it is noted that the gas content appears to have a significant influence on crack formation. M.W.R.

N66-33004# Joint Publications Research Service, Washington, D. C.

RATIONAL CONDITIONS FOR THE MECHANICAL-THERMAL PROCESSING OF THE TITANIUM ALLOYS VT15 AND ITS WELDED JOINTS

M. Kh. Shorshorov, G. Ye. Kainova, B. A. Smirnov, and V. N. Meshcheryakov *In its* Mech. and Eng. Properties of Titanium Alloys 26 Jul. 1966 p 156–164 refs (See N66-32986 19-17) CFSTI: $6.00

Strength and plasticity are increased for a metastable β-alloy of titanium (VT15) and its welded joints by mechanical–thermal processing, and plastic deformation of this β-phase occurs at 400 to 450°C. If this deformation should occur at room temperature, heating of the titanium alloy to between 600 and 650°C will result in a favorable combination of strength and plasticity. If hardening of the alloy, and particularly its welded joints, takes place at a temperature between 1100 and 1200°C, then chemical inhomogeneity is eliminated in the metal. M.W.R.

N66-33005# Joint Publications Research Service, Washington, D. C.

CHANGE IN STRUCTURE AND PROPERTIES OF THE BASIC MATERIAL AND THE WELDED JOINTS OF THE ALLOY VT15 DURING HEAT TREATMENT

Ye. A. Guseva, M. A. Komarov, L. P. Vorub'yeva, and I. A. Savitskiy *In its* Mech. and Eng. Properties of Titanium Alloys 26 Jul. 1966 p 165–173 refs (See N66-32986 19-17) CFSTI: $6.00

Aging process of the basic material and the welded joints of VT15 titanium alloy was investigated using materials from an industrial melt. Hardening of the basic metal alloy has no influence on mechanical properties, but in the welded joints there are both property and structural changes. In the cast metal of the weld a two-phase structure is observed which has a dendritic structure; after hardening with temperatures between 800 and 1000°C, only one phase is observed. The dendritic inhomogeneity, however, does not disappear. There is a sharp decrease in impact viscosity of the weld metal after hardening. Decomposition of the β-phase in the hardened alloy takes place in at least two stages, as indicated by study of electrical resistance changes during aging. An anomalous change in the electrical resistance when aging first begins is probably related to diffusion processes in the solid solution; and this is followed by a drop in electrical resistance which is apparently related to the formation of the α-phase. M.W.R.

N66-33006# Joint Publications Research Service, Washington, D. C.

PROCEDURES FOR OBTAINING HIGH-TEST TITANIUM WELDS WITHOUT WORK HARDENING HEAT TREATMENT

S. M. Gurevich, N. A. Kushnirenko, and V. Ye. Blashchuk *In its* Mech. and Eng. Properties of Titanium Alloys 26 Jul. 1966 p 174–179 (See N66-32986 19-17) CFSTI: $6.00

Since heat treatment does not result in work hardening of the α-phase titanium alloys, the welded seams of these alloys must have their ultimate strength immediately after welding. It is shown that the welded seams of a Ti–Al–Sn–V–Zr–Fe alloy has practically the same strength as the basic metal; indicating that alloying of single phase seams obtains high strength and plastic welded joints. In two-phase $(\alpha+\beta)$ welded seams, a strength increase occurs when the alloy is welded with an electrode rod of the same type; and although heat treatment further increases strength, it leads to a sharp drop in plasticity. A method is described whereby a welded joint equal in strength and hardness to the basic metal can be obtained. M.W.R.

N66-33007# Joint Publications Research Service, Washington, D. C.

DIFFUSION BRAZING OF TITANIUM

A. Ya. Shinyayev and V. V. Bondarev *In its* Mech. and Eng. Properties of Titanium Alloys 26 Jul. 1966 p 180–183 refs (See N66-32986 19-17) CFSTI: $6.00

The structure of the diffusion zones formed during brazing of two titanium alloys (AT3 and OT4) is investigated over a broad temperature range and time period, and using intermediate layers of copper and a cobalt–nickel–copper alloy. Standard plating baths were used for the deposition, and brazing was accomplished in a vacuum with a sample pressure of 3 to 5 kg/mm^2. Diffusion brazing via copper plated layers does not take place at temperatures lower than 885°C even after several hours. At higher temperatures a liquid eutectic layer and porous joints are formed; and the strength of the joints increased to 25 kg/mm^2 at a temperature of 940°C. With three-layer electroplating, strength of the brazed joints increased; a large layer of eutectic was formed, however, along which failure occurred. At temperatures above 940°C this eutectic layer was partially resorbed. Investigation made with electroplated coatings of between 6 and 9 mk indicated that at temperatures above 930°C, mutual diffusion between titanium and coating took place; and the microhardness of the diffused layers is at a high level. Retardation in the diffusion rate is found to result in less crack formation. M.W.R.

N66-33008# Joint Publications Research Service, Washington, D. C.

DIFFUSION LAYERS AND THE STRENGTH OF BRAZED JOINTS OF TITANIUM USING ELECTROPLATING OF NOBLE METALS

V. V. Bondarev and A. Ya. Shinyayev *In its* Mech. and Eng. Properties of Titanium Alloys 26 Jul. 1966 p 184–187 refs (See N66-32986 19-17) CFSTI: $6.00

Adhesive strengths of electroplatings of gold, platinum, palladium, and rhodium on titanium and its alloys are investigated under various heat treatments. The electroplatings applications were on a film of titanium hydride in order to insure direct contact between plating and base material. Heat environment appears to significantly influence adhesive strength, apparently because of the relative porosities of the electroplatings. The best adhesion results from processing in an atmosphere of pure argon or helium, or in a vacuum. When brazing with copper–silver solders, using a gas burner, strength did not exceed 0.8 to 1.2 kg/mm^2. Vacuum heating for one to two hours at 100 to 500°C and subsequent brazing with soft solders has no significant effect on adhesive strength; at temperatures as high as 750°C there are increases, but for platinum, palladium, and rhodium a high of 1.4 kg/mm^2 is achieved. Annealing at 750 to 900°C, with a delay time of one-half to two hours gave the same results as brazing in a vacuum. M.W.R.

N66-33009# Joint Publications Research Service, Washington, D. C.

SOME CONDITIONS FOR ROLLING TITANIUM ALLOYS

I. M. Paulov, Ye. G. Konstantinov, A. Ye. Shelest, and Yu. F. Tarasevich *In its* Mech. and Eng. Properties of Titanium Alloys 26 Jul. 1966 p 188–193 refs (See N66-32986 19-17) CFSTI: $6.00

Data are presented to aid in developing thermal–mechanical conditions for rolling, to correct existing manufacturing processes, and to design special equipment for the pressure treatment of titanium alloys. Various experiences with rolling bars of titanium alloys are reported, and forward slips and coefficients of friction obtained during hot and cold rolling of titanium alloys are tabulated. Dependency of these parameters on width of the titanium strip is graphed, a method is diagrammed for measuring the friction moment in the bearings of a rolling mill, and the index of displacement is shown as a function of temperature when rolling certain titanium alloys. A formula is given to determine the torsion moment on rolling with respect to the known pressure and the length of the center of deformation. M.W.R.

N66-33010# Joint Publications Research Service, Washington, D. C.

SHEET METAL STAMPING OF TITANIUM AND CHEMICAL MACHINE BUILDING

A. P. Golovanova *In its* Mech. and Eng. Properties of Titanium Alloys 26 Jul. 1966 p 194–202 (See N66-32986 19-17) CFSTI: $6.00

Technically pure titanium (VT1) and a titanium alloy (OT4), which are used extensively for industrial purposes, are shown to be highly sensitive to various heating conditions in a general review related to sheet metal stamping of titanium. Data are presented of the following operations related to the use of titanium and the titanium alloy in manufacturing the necessary chemical apparatus: (1) bending and roll forming, (2) drawing, (3) flanging, (4) expanding tubes, (5) wedging, and (6) cutting and punching. Heating to temperatures required for hot working of the metals has no influence on resistance to corrosion; and the corrosion resistance of the samples tested does not depend upon the radius of the bend and the procedure used for cutting out the samples. M.W.R.

N66-33011# Joint Publications Research Service, Washington, D. C.

THE POSSIBILITIES OF USING TITANIUM ALLOYS FOR SURGICAL INSTRUMENTS, APPARATUS AND TISSUE SPLICING AGENTS

N. F. Belavin and V. G. Shakhmatov *In its* Mech. and Eng. Properties of Titanium Alloys 26 Jul. 1966 p 203–207 refs (See N66-32986 19-17) CFSTI: $6.00

Data obtained from bending tests on several titanium alloys were compared with strength tests conducted with stainless martensitic steel 3Kh13. The results indicate that titanium alloys VT5-1, OT4-1, and VT14 have about the same strength when bending. The steel in the hardened state has somewhat greater strength and rigidity but cannot be used for insertion in an organism because of corrosion. An outline of a process used to put a nickel-phosphorus coating on titanium alloys to increase their wear resistance when used in surgical apparatus, is given. Some titanium alloy samples nickel plated by the procedure were tested for friction on a machine, and the results indicate that the coating does indeed increase the wear resistance. L.S.

N66-33012# Joint Publications Research Service, Washington, D. C.

THE COEFFICIENT OF LINEAR EXPANSION OF TECHNICAL TITANIUM

A. I. Nikonorova, S. L. Simeonov, L. V. Karabasova, G. V. Dubovaya, and N. P. Soboleva *In its* Mech. and Eng. Properties of Titanium Alloys 26 Jul. 1966 p 208–214 refs (See N66-32986 19-17) CFSTI: $6.00

The results of drawing tests together with X-ray investigations indicate that the coefficient of linear expansion of technical titanium is greatly influenced by the texture of the sample. This in turn is directly related to the industrial process of pressure treatment, and to the temperature and deformation diagram used. Therefore to obtain a more homogeneous coefficient of linear expansion, homogeneous conditions of deformation must be provided when making semifinished titanium products. The value of the coefficient of linear expansion on several titanium billets forged under controlled conditions (temperature range of 700 to 950°C, the α-phase region) was checked, and the possibility of stabilizing the coefficient of linear expansion of technical titanium VT1-1 within the limits of 8.5 $\pm 0.5 \times 10^{-6}$/deg was indicated. L.S.

N66-33019*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

METALLOGRAPHIC STUDY OF DISPERSION-STRENGTHENED ALLOYS AFTER FAILURE IN STRESS RUPTURE

Charles A. Hoffman and John W. Weeton Washington, NASA, Aug. 1966 36 p refs

(NASA-TN-D-3527) CFSTI: HC $2.00/MF $0.50 CSCL 11F

A metallographic study was conducted on stress–rupture failed specimens of a number of dispersion-strengthened materials to obtain additional insight into the microstructural factors affecting their stress–rupture strengths. This study led to the following conclusions: (a) in general, the dispersion strengthened materials investigated herein that exhibited best overall retention of stress–rupture strength had the most stable microstructures, (b) those products which contained appreciable amounts of excess particles had good strength and stability at lower temperatures, but at higher temperatures their strengths decreased at a more rapid relative rate, and their microstructures exhibited increased porosity. The observed porosity is believed related to impurities, (c) there was no unique fracture mode that could be associated with those materials that retained a relatively greater portion of their stress–rupture strength at high temperatures, (d) the best overall retention of stress–rupture strength with in-

creased use temperature was associated with materials having rather uniformly distributed dispersoid particles with fine characterizing dimensions (<0.050 μ), and (e) large particles, such as the $FeAl_3$ inclusions in an Al+5 volume percent Al_2O alloy, may be deleterious. Author

N66-33023*# General Dynamics Corp., San Diego, Calif.
DIFFUSION AND ELECTRON EMISSION ON PROPERTIES OF DUPLEX REFRACTORY METAL THERMIONIC EMITTERS
R. G. Hudson and L. Yang Washington, NASA, Aug. 1966 29 p refs
(Contract NAS3-4165)
(NASA-CR-529) CFSTI: HC $2.00/MF $0.50 CSCL 11F

The diffusion and the electron emission properties of the rhenium–tungsten and the iridium–tungsten duplex emitter systems have been studied at 1600° to 2100°C in order to assess the usefulness of these systems in thermionic applications. The Re–W samples were prepared by depositing rhenium formed by the pyrolysis of $ReCl_5$ at 1000°C on one side of tungsten disks or tubing formed by the reduction of WF_6 with hydrogen at 550°C. The Ir–W samples were prepared by depositing tungsten formed by the reduction of WF_6 with hydrogen at 550°C on iridium disks of powder metallurgy origin and 99.99% purity. Gross diffusion-anneal was carried out in a high-temperature resistance furnace, and the rates of growth of the various phases in the diffusion zones of these systems were measured by metallographic and electron microprobe techniques and compared with the results of other workers. The electron emission properties of these systems were followed as a function of time during diffusion-anneal in a diffusion–emission cell designed for this purpose. Author

N66-33030# United Kingdom Atomic Energy Authority, Harwell (England). Metallurgy Div.
THE THEORETICAL STRENGTH OF CERMETS CONTAINING SPHEROIDAL CERAMIC PARTICLES
B. R. Butcher and B. W. Howlett Mar. 1966 14 p refs
(AERE-M-1728)

The most successful simple model so far developed to account for the tensile yield strength of cermets containing unbonded spheroidal ceramic particles depends on geometry of simple cubic packing. However, this model cannot be realistic as some of the specimens which obey this rule must have contained some form of close packing, since their volume fraction was greater than the limit imposed by simple cubic packing. In this note an expression is derived for the tensile yield strength using a close packed structure. This gives a very similar result to that based on simple cubic packing. Author

N66-33035# United Kingdom Atomic Energy Authority, Risley (England). Reactor Group.
THE STRAIN RATE SENSITIVITY OF THE YIELD STRESS OF STEELS
G. D. Fearnehough 1966 24 p refs
(TRG-1248(C)) CFSTI: HC $1.00/MF $0.50

The dynamic yield stress has been calculated from the general yield load of Charpy specimens fractured in an instrumented impact machine. Several mild and low alloy steels were investigated over a range of temperatures together with the effects of neutron irradiation. The results show that, for the unirradiated condition, the high yield stress steels are less strain rate sensitive than the low yield stress steels. The low strain rate sensitivity which accompanies high friction stress values is interpreted in terms of the relatively large obstacles to dislocation motion which are not easily overcome with the aid of thermal activation. Irradiation does not result in the expected reduction in strain rate sensitivity which the increase in yield stress would suggest. This indicates that irradiation hardening is due to the presence of relatively small obstacles. The temperature sensitivity of the yield stress is unaltered by irradiation, indicating that irradiation hardening is athermal in nature. Author

N66-33105# United Kingdom Atomic Energy Authority, Harwell (England). Metallurgy Div.
THE FABRICATION AND PROPERTIES OF FINE AND COARSE DISPERSIONS OF URANIUM DIOXIDE IN A BERYLLIA MATRIX
N. A. Hill, I. E. Denton, and W. Munro Mar. 1966 14 p refs
(AERE-R-5182)

Beryllia specimens containing 15 v/o or 20 v/o uranium dioxide uniformly dispersed as either spheres ~200μ diameter or powder <3μ diameter have been fabricated to a high density with <0.8% open porosity and a krypton gas permeability coefficient of $K < 1.2 \times 10^{-11}$ cm²/sec. The specimens have been ground to sizes suitable for stem rig irradiations and in pile thermal conductivity measurements. The powder dispersions had 3 point bend strengths of 32,000–48,000 psi and Young's Modulus (E) of 55×10^6 psi. Corresponding figures for the ~200μ sphere dispersions were, strength 17,000–22,000 psi, $E = 40 \times 10^6$ psi. Author

N66-33164# Bureau of Mines, Albany, Oreg.
HIGH-ENERGY-RATE EXTRUSION OF LOW-DENSITY TUNGSTEN POWDER BILLETS
Jack G. Croeni, John S. Howe, Jr., and H. Kato 1966 20 p ref
(BM-RI-6817)

The Bureau of Mines developed a method to extrude low-density tungsten powder billets into rods and sheet bar with high-energy-rate forming equipment. Billets were compacted and sintered in an atmosphere of hydrogen to obtain a density of approximately 60 percent. Extrusion was conducted at reduction ratios of 6.25 to 1 and 9 to 1 at 1,800°C to produce high-density, sound material. Yield strengths obtained were higher than those of material produced by conventional powder-metallurgy techniques, but ductility was lower at high temperatures. Author

N66-33218# Martin Co., Baltimore, Md.
RELATIONSHIP OF SURFACE EFFECTS TO THE MECHANICAL BEHAVIOR OF METALS Summary Report, 1 Feb.–30 Jul. 1966
I. R. Kramer Wright-Patterson AFB, Ohio, AF Mater. Lab., Jan. 1966 77 p refs
(Contract AF 33(657)-10509)
(AFML-TR-66-2; AD-630661) CFSTI: HC $3.00/MF $0.75

The role of the surface is discussed in terms of its effect on the mechanical behavior of metals. There is adequate evidence which demonstrates that a region of high dislocation concentration exists in the region at the surface of a deformed metal. This dislocation rich layer impedes the movement of mobile dislocations. It was shown in aluminum by means of strain rate cycling tests that for a given applied stress, the average velocity of the dislocations is affected by the surface. It appears possible to explain the surface effects in terms of stress field associated with the surface layer. For aluminum crystals additional internal dislocation barriers were not formed in Stage I and it was possible to show that Stage I ends when the difference between the applied stress and the surface stress on the secondary slip system equals the critical resolved shear stress. The effect of the surface was found to be greater on polycrystalline specimens than on single crystals. For Armco iron, the surface stress was almost twice as great as that due to internal obstacles. It is also shown that

the yield point in high purity metals is associated with the surface layer. Author (TAB)

N66-33219# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF DIFFUSION OF SILICON AND TITANIUM IN NIOBIUM
P. M. Arzhanyy, R. M. Volkova, and D. V. Prokoshkin 22 Jan. 1965 13 p refs Transl. into ENGLISH from Tr. Inst. Met. Akad. Nauk SSSR (Moscow), no. 11, 1962 p 78–82
(FTD-TT-64-710/1+2; TT-65-61564; AD-610798) CFSTI: HC $1.00/MF $0.50

A study was made of the structure and phase makeup of thermo-diffusion saturation of niobium by silicon and titanium. It was shown that in the process of diffusion of silicon and titanium on the surface of the niobium there is formed a phase of $NbSi_2$ with the titanium dissolved in it (up to 5% by weight), and having a hexagonal lattice with the parameters: a = 4.779 kX; c = 6.493 kX. An investigation was made of the kinetics of the oxidation of niobium saturated by silicon and titanium. The structure and phase makeup of the oxidized film was determined. It was shown than the surface of niobium saturated by silicon and titanium at a temperature of 1,200 oxidizes to lesser extent by a factor of almost one and a half than the surface of niobium saturated by silicon alone. In this situation a thin scale is formed which is tough and well connected with the surface of the niobium. TAB

N66-33222# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INFLUENCE OF RESIDUAL STRESSES ON THE FATIGUE STRENGTH OF STEEL WITH AN ACUTE STRESS CONCENTRATION
I. I. Ishchenko and I. A. Malinovs'ka *In its* Rept. of the Acad. of Sci. of the Ukrain. SSR 15 Mar. 1966 p 1–5 refs (See N66-33221 19-17) CFSTI: HC $1.00/MF $0.50

The influence of induced residual compressive or tensile stresses on the fatigue and corrosion-fatigue strengths of 12KhNZA steel was established on the basis of tests run on deformed notched specimens. The specimens were 15 mm in diameter with an acute open notch 4 mm deep having a radius of 0.3 mm at the bottom. Conclusions are that the residual stresses induced in steel components with stress concentrators affect fatigue strength in air and in water, and that tensile stresses are dangerous for specimens with open notches.
C.T.C.

N66-33246# Franklin Inst., Philadelphia, Pa. Research Labs.
DEFORMATION STRUCTURES IN ZONE-MELTED MOLYBDENUM ABOVE ROOM TEMPERATURE
A. Lawley Sep. 1965 30 p refs
(Contract Nonr-4434(00))
(I-B2195-2; AD-633600) CFSTI: HC $2.00/MF $0.50

Stress–strain behavior of single crystal molybdenum oriented for slip on the (011) (111) slip system has been examined at 578°K; the associated glide dislocation configurations have been characterized by thin film transmission electron microscopy. A high density of prismatic loops is observed elongated along (211). Few long segments of primary screw dislocation exist, but there are serrated, angular, and cusp-shaped segments of short length. The debris of dislocation loops has the same Burgers vector as the primary screw dislocations. Dislocation tangling is restricted to the immediate vicinity of inclusions or pinned grown-in dislocations. In comparison, the slip band structure in the range 4.2–300°K is characterized by the presence of long primary screw dislocations of Burgers vector ±a/2 (111). Jog formation at 578°K is most likely the result of thermally activated cross-slip. However, it is possible that the magnitude of the dislocation uncertainty perpendicular to the slip plane in molybdenum at this temperature is sufficient to provide job heights consistent with the width of the observed elongated prismatic loops. The work-hardening level is controlled by the extent of secondary slip, and by the recovery occurring through cross-slip.
Author (TAB)

N66-33249# Franklin Inst., Philadelphia, Pa. Research Labs.
ETCH-PITTING CHARACTERISTICS OF HIGH-PURITY MOLYBDENUM
H. L. Prekel and A. Lawley Jul. 1965 38 p refs
(Contract Nonr-4434(00))
(I-B2195-1; AD-633601) CFSTI: HC $2.00/MF $0.50

The etch-pitting behavior of single and polycrystalline molybdenum was examined using various etching solutions and prior heat treatments. Murakami's solution, Wolff's solution, oxalic acid and sulphuric acid in methanol are found effective on planes in a region 30 degrees about <001>, however it is shown that a one to one correspondence between etch-pits and dislocations does not necessarily exist. A plane about 11 degrees from <112> towards <012>, which is to be the observation plane in the dislocation velocity studies, was examined in detail. Reliable and reproducible pitting of dislocation sites occurs on this plane with a diluted Murakami's solution. A one to one correspondence between etch-pits and dislocations was positively established by transmission electron microscopy of thin foils of this orientation etched prior to examination. The etch-pit shape depends critically on the crystal orientation but is independent of the nature or Burgers vectors of the dislocations. Annealing of molybdenum single crystals at about 1900°C in hydrogen for 8 hours lowers the dislocation density from about $10^8/cm^2$ to $10^6/cm^2$ as determined from both etch-pitting and transmission electron microscopy. The dislocation density is reduced by (i) complete removal of carbides in the metal matrix (the carbides being responsible for the high in-grown dislocation density) and (ii) rearrangement of the dislocations into sub-grain boundaries. Author (TAB)

N66-33254# Case Inst. of Tech., Cleveland, Ohio. Dept. of Metallurgy.
MECHANICAL PROPERTIES OF TANTALUM SINGLE CRYSTALS
W. A. Spitzig and T. E. Mitchell 1965 263 p refs
(Grant AF-AFOSR-829-65)
(AD-633722) CFSTI: HC $6.00/MF $1.25

Three-stage hardening has been found to occur in tantalum single crystals deformed in tension over a limited range of orientations, temperatures and strain-rates. The orientation range is for crystals oriented favorably for single glide. The temperature range corresponds to $T/T_m \simeq 0.10$ to 0.18. The work-hardening rate in stage II is about G/600. The dislocation structure in tantalum single crystals exhibiting three-stage hardening has been investigated by transmission electron microscopy. In stage I tangles of dislocations containing many straight screw dislocations are seen lying parallel to the slip plane. In stage II an elongated cell structure develops with tangles of dislocations increasing in density and becoming linked together. Misorientations across cell boundaries become increasingly apparent with increasing deformation in stages II and III. A quantitative theory of work-hardening is presented for stage II in body-centered cubic metals which is an adaptation of a recent theory proposed by Hirsch.
Author (TAB)

N66-33268# Dayton Univ., Ohio. Research Inst.
BALLISTIC BEHAVIOR OF ADHESIVELY BONDED HONEYCOMB ALUMINUM PANELS FOR AIRCRAFT, PART II
Interim Report, 15 Oct. 1965–15 Apr. 1966

Robert F. Rolsten, Harold H. Hunt, and R. J. Vossler May 1966 27 p Prepared jointly with AF Mater. Lab., Wright-Patterson AFB, Ohio
(Contract AF 33(615)-2040)
(AFML-TR-66-135; AD-633621) CFSTI: HC $2.00/MF $0.50

Adhesively bonded honeycomb panels commonly used with high-performance aircraft were subjected to ballistic impact from a military .30 calibre round to analyze target response qualitatively. Structural panels were impacted by a 150-grain projectile traveling at about 3000 ft/sec at angles of 90 (normal), 45 and 15 degrees. These data were duplicated and verified by independent tests conducted at the ballistic research laboratories (BRL), Aberdeen, Maryland. In addition, BRL conducted impact tests with a military .50 calibre as well as simulated high-explosive fragments for assessment of the problem of deflagration and conflagration of fuel. It can be concluded from the data that grazing impacts can cause extensive damage to adhesively bonded honeycomb panels. Careful consideration should be given to the hazards involved when such construction is utilized on attack aircraft.
Author (TAB)

N66-33274# Naval Research Lab., Washington, D. C.
THE INTERPRETATION OF ELECTRON MICROSCOPE FRACTOGRAPHS Final Report
C. D. Beachem 21 Jan. 1966 51 p refs
(NRL-6360; AD-633770) GPO: $0.50

The report was prepared to aid the relative newcomer to electron fractography in the interpretation of fractographs. Accurate interpretation depends on understanding the effects of electron microscope and replica variables on photographic densities in the fractographs. Briefly, some of these effects are as follows: contrast decreases with increasing electron gun potential and lens aperture size, electron density decreases and hence photographic density in the printed fractograph increases with the amount of replica material penetrated by the electrons. This, in turn, increases with an increase in the local thickness of the replica or with a decrease in the angle between the local replica surface and the incident electron beam. The thickness of the replica depends on the vacuum in the bell jar during formation of the replica, the angle of the local feature with respect to the depositing metal or carbon, and the distance between the feature and the source of the carbon or metal. During shadowing, convex features cast external shadows and tend to grow larger, while concave features contain their shadows and tend to remain the same size but to fill up with shadowing material. Interpretation is aided by stereoscopic viewing and by precision matching of mating fracture surfaces. Replica fidelity is a function of the choice of replication technique, with the direct carbon process generally being superior, and of the shape of both the features under study and immediately adjacent portions of the replicas.
Author (TAB)

N66-33365# Joint Publications Research Service, Washington, D. C.
NIOBIUM—METAL OF THE SPACE AGE
I. M. Nedokha and V. G. Chernyy 28 Jul. 1966 43 p refs Transl. into ENGLISH from the Monograph "Niobiy—Metall Kosmicheskoy Ery" Kiev, 1965 p 5-6; 15-16; 25-31; 38-41; 44-49; 54-75
(JPRS-36718; TT-66-33149) CFSTI: $2.00

A narrative account is given of the state-of-the-art development of niobium. The following are discussed: (1) electron beam melting for preparation of near chemical pure niobium; (2) physical, chemical, and mechanical properties with emphasis upon heat resistance, plastic deformation, oxidation resistance, and recrystallization; (3) processing methods including hot and cold extrusion, cold rolling, forging, stamping, heat treatment, and annealing; (4) the various compounds of niobium, including oxides, carbides, nitrides, silicides, and borides; (5) the uses of niobium carbide alloys, particularly in cutting tools; and (6) the applications of niobium in electronics and chemical engineering. In addition, a short history is presented of the uses of refractory metals, in general, in present-day aerospace technology.
D.T.

N66-33404*# Rice Univ., Houston, Tex.
EASY GLIDE IN MOLYBDENUM CRYSTALS
L. D. Whitmire and F. R. Brotzen [1966] 9 p refs
(Grant NsG-6-59)
(NASA-CR-77030) CFSTI: HC $1.00/MF $0.50 CSCL 11F

By using direct shear on the (110) [111] system of 0.125" dia electron-beam zone-refined molybdenum crystals, easy glide was observed at temperatures greater than 300°K for a shear-strain rate of 4×10^{-5} sec^{-1}. It is noted that at higher strain rates a greater temperature is necessary for the observation of easy glide. The extent of the easy glide was dependent on the purity of the crystals; and, generally, only crystals with a resistence ratio,

$$\left[\frac{R(273^\circ K)}{R(4.2^\circ K)}\right]$$

of better than 2500 gave any indication of easy glide; and slope of the stress-strain curves in the easy-glide region depended upon temperature and strain rate. The sensitivity of easy glide to impurities might be related to increased flow stresses in the impure material which enhance secondary slip.
M.W.R.

N66-33405*# Rice Univ., Houston, Tex.
THE EFFECTS OF DEFORMATION ON THE ELECTRICAL RESISTIVITY OF MOLYBDENUM SINGLE CRYSTALS
L. D. Whitmire and F. R. Brotzen [1966] 26 p refs
(Grant NsG-6-59)
(NASA-CR-77029) CFSTI: HC $2.00/MF $0.50 CSCL 11F

Single crystals of high-purity molybdenum were deformed at temperatures from 195 to 473°K, and the effect of deformation on the electrical resistivity was determined. To separate the resistivity components of point and line defects some crystals were annealed at 473°K. The rate of resistivity increase with strain was nearly linear and was strongly dependent upon the deformation temperature. Point defects are annealed out without any effect on the flow stress. At low temperatures the flow stress is a linear function of the square root of the resistivity increase attributable to dislocations.
Author

N66-33410*# Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Materials Engineering.
EXPERIMENTAL X-RAY STRESS ANALYSIS PROCEDURES FOR ULTRA HIGH STRENGTH MATERIALS
H. R. Woehrle, F. P. Reilly, III, W. J. Barkley, III, L. A. Jackman, and W. R. Clough [1964] 24 p refs Presented at Ann. Conf. on Appl. of X-ray Analysis, Denver, Aug. 1964 Submitted for Publication
(Grant NsG-100)
(NASA-CR-59602) CFSTI: HC $1.00/MF $0.50 CSCL 11F

The development and evaluation of various workable X-ray stress analysis procedures which accurately measure high elastic strains in maraging, ausformed, and cold drawn steels are discussed. A two-exposure X-ray technique, in particular, gave very satisfactory results. In this technique a special fixture was designed and constructed to allow uniaxial straining of test specimens while in the X-ray unit. Imposed strains were measured directly by strain gauges mounted on

the specimen. Simultaneously, strains were measured by the use of chromium radiation filtered with vanadium foil. The peak resolution obtained was very satisfactory with a peak to background ratio of about 4:1 for the [211-121] martensite doublet used to measure the shift in peak location between the normal and oblique exposures. Data plots of the stresses of the material samples tested are given. L.S.

N66-33427# National Aero- and Astronautical Research Inst., Amsterdam (Netherlands).
REPORTS AND TRANSACTIONS, VOLUME XXXI
1965 122 p refs Sponsored by Neth. Aircraft Develop. Board
CFSTI: HC $4.00/MF $1.00

A number of reports on crack propagation are presented and include fatigue crack propagation in unnotched and notched aluminum alloy specimens, the influence of the mean stress on the propagation of fatigue cracks in aluminum alloy sheet, the effect of sheet thickness on the fatigue crack propagation in 2024-T3 Alcad sheet material, the effect of heat treatment on the propagation of fatigue cracks in light alloy sheet material, the effect of temperature and frequency on the fatigue crack propagation in 2024-T3 Alcad sheet material, and the effect of the sheet width on the fatigue crack propagation in 2024-T3 Alcad material. R.N.A.

N66-33432*# Battelle Memorial Inst., Columbus, Ohio.
INVESTIGATION OF MECHANICAL PROPERTIES OF CHROMIUM, CHROMIUM-RHENIUM, AND DERIVED ALLOYS Twenty-Third Quarterly Progress Report, Oct. 1, 1965–Mar. 31, 1966
A. Gilbert and M. J. Klein 1 Jun. 1966 25 p refs
(Contract NASw-101)
(NASA-CR-76856) CFSTI: HC $1.00/MF $0.50 CSCL 11F

As an extension of a previously described work on unalloyed chromium, an investigation was conducted on wires of Cr-35Re containing two different levels of nitrogen. The bend properties were determined for material of the two nitrogen levels in the quenched conditions and after two different aging treatments. Internal friction techniques were used to monitor the amount of nitrogen actually in solution. Results indicate that the change in bend-transition temperature of Cr-35Re wire produced by changes in impurity level and heat treatment reflect the effect of these variables on the deformation response of the matrix. R.N.A.

N66-33474# Case Inst. of Tech., Cleveland, Ohio. Dept. of Metallurgy.
CONTROL OF CAST GRAIN SIZE OF STEEL COATINGS. EFFECT OF GRAIN REFINEMENT ON PROPERTIES Interim Report, 16 Aug. 1964–30 Sep. 1965
N. Church, P. Wieser, and J. F. Wallace [1965] 81 p refs
(Contract DA-33-019-AMC-273(Z))
(AMRA-CR-64-04/2; AD-634343) CFSTI: HC $3.00/MF $0.75

Inoculation techniques were developed to refine the as cast structure of high strength steel. Titanium was found to be the most effective inoculant. Large titanium additions (0.6%) form sulfides which embrittle the steel. Small titanium additions (0.1%) together with controlled superheat and mold design may produce significant refinement. Under these conditions the structure of unidirectionally solidified castings was changed from columnar to equiaxed and the reduction in area increased by approximately 25% for specimens oriented vertically to the direction of heat flow and increased about 75% for horizontally oriented specimens. A small improvement in reduction in area of keel block castings was obtained by this method. Some improvement in toughness was also obtained by this grain refinement. The influence of vacuum melting on the cast structure of the same steel was investigated. A hypothesis explaining the mechanism of refinement by vacuum melting was proposed. Author (TAB)

N66-33504*# TRW, Inc., Cleveland, Ohio. Materials and Processes Dept.
DEVELOPMENT OF HIGH TEMPERATURE NICKEL-BASE ALLOYS FOR JET ENGINE TURBINE BUCKET APPLICATIONS Second Interim Engineering Report, 1 Oct. 1965–31 May 1966
H. E. Collins 20 Jun. 1966 145 p refs
(Contract NAS3-7267)
(NASA-CR-72011; TRW-ER-6873) CFSTI: HC $3.00/MF $1.00 CSCL 11F

A screening study was conducted in which 75 experimental compositions were melted, cast and evaluated on the basis of mechanical property, micro-structure and workability results. From this study, three promising cast and five promising wrought alloys were established and recommended for a more complete property evaluation. The elements most influential in improving stress rupture life were Ta, W Hf, Al, and Cr. It is stated that these elements, in the percentages suggested, generally increase life and tensile strength, but they normally decrease ductility and workability. The data obtained from these investigations are given, and the alloy candidates recommended for further evaluation are identified. H.S.W.

N66-33514# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
THE EFFECTS OF INTERSTITIAL SOLUTE ELEMENTS ON THE FATIGUE LIMIT BEHAVIOR OF TITANIUM Final Technical Documentary Report, Feb. 1957–Feb. 1966
Harry A. Lipsitt, James A. Roberson, and Douglass Y. Wang Mar. 1966 52 p refs
(ARL-66-0052; AD-634518) CFSTI: HC $2.00/MF $0.50

The fatigue behavior of titanium and three titanium–interstitial alloys, each containing about 1/4% of C, N, or O, has been investigated through the temperature range of 70°F to +500°F and at liquid nitrogen temperature. The fatigue limit stress was found to vary with temperature in a more or less consistent fashion depending on the interstitial type and total interstitial content. The position of the fatigue limit knee does not vary in a consistent fashion with temperature, since the rate of strain aging, the process which is believed to be responsible for the fatigue limit, depends both on the temperature and the type of interstitial involved. It was found that the small amounts of the interstitials listed above cause marked changes in the fatigue limit stress. The effect of carbon seems to be the most pronounced insofar as strain aging is concerned, but the nitrogen alloy was far stronger at every temperature investigated. Author (TAB)

N66-33546# Battelle-Northwest, Richland, Wash.
METALLURGY RESEARCH SECTION Quarterly Progress Report, Oct.–Dec. 1965
4 Apr. 1966 143 p refs
(Contract AT(45-1)-1830)
(BNWL-207) CFSTI: HC $3.00/MF $1.00

Research is summarized on physical metallurgy, reactor metals, chemical metallurgy, and materials engineering. Sixteen separate abstracts were prepared for individual sections. Summaries of papers being prepared for publication on the following subjects are included: steady-state creep of plutonium, characteristics of the $\beta \rightarrow \alpha$ and $\alpha \rightarrow \beta$ transformations in plutonium, phase transformation damage in plutonium, kinetics of the $\alpha \rightarrow \beta$ and $\beta \rightarrow \alpha$ transformations of plutonium in the vicinity of equilibrium, and effects of irradiation and environment on the mechanical properties and hydrogen pickup of Zircaloy-2. NSA

N66-33553# California Univ., Livermore. Lawrence Radiation Lab.

DIFFUSION OF Fe IN AN Fe–Al ALLOY

D. Y. F. Lai and R. J. Borg 24 Mar. 1966 5 p refs
(Contract W-7405-ENG-48)
(UCRL-14752) CFSTI: HC $1.00/MF $0.50

Values for the diffusion coefficients of Fe in an alloy containing 5.7 at. % Al are reported. The measurements run from 850° to 1185°C. The activation energy was found to be somewhat higher than was expected. Data are tabulated. NSA

N66-33554# Rocky Flats Div., Dow Chemical Co., Golden, Colo.

A STUDY OF THE EFFECTS OF ADDITIVES ON SINTERED TUNGSTEN POWDER COMPACTS

C. E. Williams and V. R. Friebel 13 May 1966 27 p refs
(Contract AT(29-1)-1106)
(RFP-706) CFSTI: HC $2.00/MF $0.50

The effects of uranium oxide, nickel, and palladium, additions on sintering and mechanical properties of isostatic-pressed tungsten powder compacts was investigated. A comparison was also made between slip casting and isostatic pressing for tungsten fabrication. Nickel and palladium lowered the sintering temperature, while uranium oxide increased the mechanical properties. The diametral compression test for measuring relative tensile strengths was evaluated and used during the investigation. Electron fractography was used to study the fractures. Author (NSA)

N66-33557# California Univ., Livermore. Lawrence Radiation Lab.

MECHANICAL PROPERTIES OF GAMMA-PHASE URANIUM-7.5 w/o NIOBIUM-2.5 w/o ZIRCONIUM ALLOY UNDER DYNAMIC LOADING

K. G. Hoge 6 Apr. 1966 13 p refs
(Contract W-7405-ENG-48)
(UCRL-14805) CFSTI: HC $1.00/MF $0.50

The effects of dynamic tension loading on the mechanical properties of gamma-phase U-7.5 wt% Nb-2.5 wt% Zr alloy are presented. Test data were taken at temperatures of 23, 200, 300, 400, and 500°C, at strain rates varying from 10^{-3} to 160 in./in.-sec. Tensile strength increased moderately with increasing strain rates, but more important was the fact that dynamic loading caused only a slight decrease in ductility. However, TTT curves for this alloy indicate that the gamma phase begins to transform to a cellular structure at temperatures slightly above 300°C in only a couple of minutes. At temperatures above 500°C it transforms into a pearlitic alpha-plus-gamma-2 structure. Author (NSA)

N66-33558# Battelle Memorial Inst., Columbus, Ohio.

FISSION-FRAGMENT EFFECTS IN STRUCTURAL MATERIALS

John A. De Mastry, Robert L. Ritzman, Neal M. Griesenauer, Edward J. Jablonowski, Frederick R. Shober et al 22 Mar. 1966 53 p refs
(Contract W-7405-ENG-92)
(BMI-1766; EURAEC-1631) CFSTI: HC $3.00/MF $0.50

Fission-fragment effects were studied in Type-304 stainless steel and Zircaloy-2 for short-time exposures at 150°C. A concentration of about 2.1×10^{14} fission fragments per cm^2 had little, if any, effect on the mechanical properties of Type-304 stainless steel or Zircaloy-2 as determined in bending. Increases of strength on the order of 7 to 10% were noted in tube-burst specimens of the structural materials. Electron fractographic studies did not reveal any changes in the fracture modes of either type of material as a result of exposure to neutron irradiation or fission fragments. Strain studies indicated that there is significant compression stress on the cladding at temperatures below 150°C. Much of this damage is expected to anneal out at higher reactor operating temperatures. Author (NSA)

N66-33563# General Electric Co., Cincinnati, Ohio. Atomic Products Div.

HIGH-TEMPERATURE MATERIALS PROGRAM Progress Report No. 58, Part A

29 Apr. 1966 60 p refs
(Contract AT(40-1)-2847)
(GEMP-58A) CFSTI: HC $3.00/MF $0.75

Brief research reports are presented along with plans for continuing experimentation. The areas of study include: (1) radiation effects on refractory metals and alloys; (2) plastic fatigue properties evaluation for heat resistant alloys; (3) radiation effects on heat resistant alloys and metals; (4) radiation effects on beryllium oxide; (5) fission product transport processes in refractory metal fuel systems; (6) clad uranium oxide physical–chemical studies in potential meltdown environments; (7) iron–chromium–aluminum clad fuel system physical–chemical studies. D.T.

N66-33589# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

ELECTRICAL AND MAGNETIC PROPERTIES OF SINGLE CRYSTALS OF RARE EARTH TUNGSTEN BRONZES AND URANIUM TUNGSTEN BRONZES

Charles V. Collins (M.S. Thesis) Mar. 1966 84 p refs
(GSP/PH/66-03; AD-633669) CFSTI: HC $3.00/MF $0.75

Rare earth tungsten bronze single crystals have been prepared for the first time by the method of electrolysis. Sodium tungsten bronze single crystals with x ranging between .37 and .81 were also prepared. Powder samples of a new tungsten bronze, uranium tungsten bronze, have been synthesized by a thermal reaction of tungsten trioxide, uranium oxide, and tungsten. Magnetic measurements indicate that uranium is tetravalent in the tungsten bronze compound. All samples were investigated by X-ray diffraction methods. Conductivity measurements were made on all samples and the metallic nature of the cubic rare earth and uranium tungsten bronzes was established. Author (TAB)

N66-33590# Naval Air Engineering Center, Philadelphia, Pa. Metallurgical Div.

INFLUENCE OF SOME PROCESSING VARIABLES UPON THE ELEVATED AND ROOM TEMPERATURE STRENGTH OF ULTRAFINE BERYLLIUM WIRES

William H. Golding 9 May 1966 28 p refs
(NAEC-AML-2441; AD-633992) CFSTI: HC $2.00/MF $0.50

An ultrafine beryllium wire was produced with a strength of approximately 150 ksi at room temperature and possessing excellent elevated temperature ductility. The application of a nickel coating to the wire allays the effects of transverse crack formation in the beryllium core until complete separation of the metals at the beryllium–nickel interface occurs at 1100°F. As a result of this protection, the elevated temperature tensile strength of the nickel clad wire is substantially greater than bare beryllium wire at all temperatures and nearly twice that of bare wires in the temperature range 600°–1100°F. The effect of a TiO_2 coating on some of the wires processed from ingot material, however, must be considered inconclusive because of the damaging influence of poor surface quality of the beryllium core. The chemical milling procedure not only improves the surface quality vastly, but tensile strength at room temperature can be increased by as much as 30 ksi. TAB

N66-33602# Army Materials Research Agency, Watertown, Mass. Materials Technology Div.
ANISOTROPY AND ITS RELATIONSHIP TO DEEP DRAWING OF A 5% CR TOOL STEEL (H11)
Robert M. Colton and James D. Colgate Apr. 1966 26 p refs (AMRA-TR-66-08; AD-634031) CFSTI: HC $1.00/MF $0.50

The drawability of a spheroidize-annealed hot-rolled H11 tool steel is shown to be most critically dependent upon hot-rolling finishing temperature, spheroidize-annealing treatment, and subsequent deep-drawing temperature. These processing variables influence drawability as indicated by their effect upon strain ratio ($R_\theta = d\epsilon_w/d\epsilon_t$) measured at an angle θ to the rolling direction, the average normal anisotropy (R), the degree of planar anisotropy (ΔR) and susceptibility to "earing", and the brittle–ductile transition temperature. Drawability is shown to increase as R increases. However, R, ΔR, and R_{45} are shown to be linearly related. As drawability increases (R>1), susceptibility to earing also increases ($|\Delta R|>0$). Values of R, ΔR, R_θ yield strength, ductility, and brittle–ductile transition temperatures for optimum drawability are presented. Author (TAB)

N66-33642# Marine Engineering Labs., Annapolis, Md.
FATIGUE PROPERTIES OF NONFERROUS ALLOYS FOR HEAT EXCHANGERS, PUMPS, AND PIPING
M. R. Gross and R. C. Schwab May 1966 31 p refs (MEL-232/66; AD-633771) CFSTI: HC $2.00/MF $0.50

The fatigue behavior of 13 nonferrous alloys used for corrosion-resistant heat exchangers, pumps, and piping systems was investigated over a broad life spectrum of 100 to 100-million cycles. Both cast and wrought copper-base and nickel-base alloys were studied. It is concluded that wrought Monel and forged Ni–Al bronze have the highest fatigue strengths, whereas gun metal and valve bronze have the lowest. The effect of salt water on fatigue performance was not found to be highly significant. The use of Langer's equation to predict stress–cycle relationships gave satisfactory results for wrought alloys but appeared to be overly conservative for cast alloys. Author (TAB)

N66-33644# Aluminum Co. of America, New Kensington, Pa. Chemical Metallurgy Div.
INVESTIGATION OF THE MECHANISM OF STRESS CORROSION OF ALUMINUM ALLOYS Final Report, Feb. 16, 1965–Feb. 16, 1966
J. Mc Hardy [1966] 127 p refs
(Contract NOw-65-0327-f)
(AD-633767)

The results suggest three stages in the stress corrosion process with the rate of penetration of corrosion or cracking increasing with each succeeding stage. In the first stage, stress corrosion takes place independently of stress, that is, it follows the same course as the general corrosion of an unstressed specimen; for the alloys investigated this general corrosion occurred as random pitting. In the second stage, the attack becomes intergranular (if not already of this type) and directional, and it leads to the development or cracks of a microscopic size, or larger; these are the secondary cracks frequently seen in specimens that faily by stress-corrosion cracking. The third stage initiates whenever one of the intergranular cracks developed in the second state progresses far enough for the yield strength of the specimen to be reached; and it continues to the point of tensile failure. Author (TAB)

N66-33687*# National Aeronautics and Space Administration, Washington, D. C.
PHASE DIAGRAM AND PROPERTIES OF ALLOYS OF THE ALUMINUM–SCANDIUM SYSTEM [DIAGRAMMA SOSTOYANIYA I SVOYSTVA SPLAVOV SISTEMY ALYUMINIY-SKANDIY]
O. P. Naumkin, V. T. Terekhova, and Ye. M. Savitskiy Jul. 1966 17 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Metally (Moscow), No. 4, 1965 p 176–182
(NASA-TT-F-10225) CFSTI: HC $1.00/MF $0.50 CSCL 11F

The phase diagram of the Al–Sc system is plotted for all concentrations. This diagram has the following basic features: There is no limit to the mutual solubility of aluminum and scandium in the molten state; four chemical compounds are formed in the system: $ScAl_3$, $ScAl_2$, ScAl and Sc_2Al; a peritectic transformation is observed on the aluminum side at 665°C with a composition close to pure aluminum, while there is a eutectic transformation on the scandium side at ~87 at. % Sc and 945°C; the solubility of scandium in aluminum at room temperature is ~0.5 at. %, while that of aluminum in scandium is ~4.0 at. %. The effect of scandium on the mechanical properties of aluminum is studied at room temperature and higher. It is found that scandium is more effective than other rare earth metals in strengthening aluminum. Author

N66-33690*# National Aeronautics and Space Administration, Washington, D. C.
HEAT-RESISTANT CHROMIUM CARBIDE COATING WITH A SILICATE BINDER [ZHAROSTOYKOYE POKRYTIYE IZ KARBIDA KHROMA S SILIKATNOY SVYAZKOY]
Ye. Antonova and N. N. Popov Jun. 1966 14 p refs Transl. into ENGLISH from Zashchita Metallov (USSR), v. 1, no. 6, 1965 p 687–691
(NASA-TT-F-10186) CFSTI: HC $1.00/MF $0.50 CSCL 11F

Investigation of the process of formation (at 1200 and 1250°C) and application to steel of a heat-resistance chromium carbide coating (84% Cr, 13.3% C) with 10, 15, 20, 30, and 50 wt.% of a low-alkaline borosilicate binder. The possibility of effective application of this coating to St 3 steel is demonstrated. The coating gives this steel good protection from oxidation in air for 200 hrs at temperatures to 1000°C; it resists thermal shocks and has adequate adhesion. Author

N66-33704*# National Aeronautics and Space Administration, Washington, D. C.
ELECTRON DIFFRACTION STUDY OF THE OXIDATION PROCESS OF THIN FILMS OF INTERMETALLIC COMPOUNDS OF THE SYSTEM NICKEL–ALUMINUM [ELEKTRONOGRAFICHESKOYE ISSLEDOVANIYE PROTSESSOV OKISLENIYA TONKIKH PLENOK INTERMETALLICHESKIKH SOYEDINENIY SISTEMY NIKEL'-ALYUMINIY]
R. I. Nazarova May 1966 12 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Khim. (Moscow), no. 7, 1964 p 1164–1167
(NASA-TT-F-10156) CFSTI: HC $1.00/MF $0.50 CSCL 11F

A method for preparing intermetallic compounds of the nickel–aluminum system in the form of thin films, by vacuum evaporation and condensation of the metal vapor until the percentage composition of the alloy corresponded to a given point of the phase diagram, is described. Electron diffraction studies were used for determining the heat resistance of the alloys and the structure of the oxide films. Simultaneous deposition of aluminum and nickel from two different evaporators on a liquid-nitrogen cooled base resulted not only in reflections characteristic of the two metals but also in reflections characteristic of the compound NiAl. Author

N66-33761# United Kingdom Atomic Energy Authority, Harwell (England). Metallurgy Div.
THE DUCTILITY OF HYDROGENATED ZIRCONIUM SHEET SPECIMENS OF VARYING THICKNESS
G. P. Walters Jul. 1965 16 p refs
(AERE-R-4981)

The effect of a constant density of hydride platelets on the tensile properties of zirconium has been studied as a function

of specimen thickness. Hydriding gave slight increases in the 0.1% proof stress and ultimate tensile strength compared with heat treated control specimens. Thin specimens were hardened slightly more than thick specimens. The decrease in elongation to fracture on hydriding was much greater in the thinner specimens however. The hydrides were found mainly at the grain boundaries in all specimens and fracture occurred across hydride platelets and at hydride-matrix interfaces. Electron microscope replica studies revealed that thin specimens failed in a brittle manner whereas the thicker specimens showed typical ductile fracture by void growth and agglomeration. Author

N66-33799# Lockheed Missiles and Space Co., Palo Alto, Calif.

THERMOELECTRIC AND GALVANOMAGNETIC PROPERTIES OF Bi–Sb SINGLE CRYSTALS

I. Ia. Khirich Jul. 1966 8 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 11, no. 5, 1966 p 501–506

In connection with the use of bismuth–3-5% antimony alloys for thermoelectric and galvanomagnetic coolers, the dependence of thermal electromagnetic frequency and the specific resistivity of temperature and magnetic field intensity was investigated. Alloy models were fabricated by zone recrystallization with an initial material purity of 99.999%; the melting zone was 20 mm. Eight passes were made over the equalization zone at a velocity of 10 mm/hr. It was found that the thermal electromagnetic frequency rises with a drop in temperature, and that the alloy was sensitive to the effect of a magnetic field, especially at temperatures below 200°K. In addition, it was found that the electromagnetic frequency and the specific resistivity rise as the magnetic field intensity increases. D.T.

N66-33824# Denver Research Inst., Colo.

RESEARCH ON THE SAMARIUM-TYPE STRUCTURE OF INTRA-RARE-EARTH BINARY SYSTEMS Final Report, 1 Jan. 1962–30 Apr. 1966

Charles E. Lundin 30 Apr. 1966 80 p refs

(Contract Nonr-3661(02))

(DRI-2326; AD-633558) CFSTI: HC $3.00/MF $0.75

A total of thirteen representative intra-rare-earth-binary systems were studied to determine the criteria of formation and the characteristics of the unusual samarium-type structure formed in these alloy systems. The techniques used in the studies included metallography, X-ray diffraction analysis, hardness, thermal analysis, resistivity, dilatometry, density, electron-beam microprobe analysis, and liquid–metal-solution calorimetry. (TAB)

N66-33838# Dartmouth Coll., Hanover, N. H. Thayer School of Engineering.

STUDIES OF METAL–CERAMIC REACTIONS IN HIGH STRENGTH STEEL CAST ALLOYS Interim Report, 1 Dec. 1964–30 Nov. 1965

Donald R. Muzyka and George A. Colligan [1965] 72 p refs

(Contract DA-19-020-AMC-00508(X))

(AMRA-CR-66-01/1; AD-633886) CFSTI: HC $3.00/MF $0.75

Experimental studies were made of reactions of mold refractory and crucible refractories with molten metal at the metal-refractory interface. Iron and iron–chromium alloys were studied in the solid and liquid state in contact with silica and stabilized zirconia refractory materials. Preliminary studies indicated the beneficial effect of chromium additions to iron in minimizing interface reaction. Based on these preliminary studies, phase equilibria and kinetic experiments were performed. Light microscopy, electron microprobe analysis, quantitative X-ray diffraction and dilatometric analysis were performed on the resulting specimens. TAB

N66-33890# Bettis Atomic Power Lab., West Mifflin, Pa.

HYDRIDE HABIT IN ZIRCONIUM AND IN UNSTRESSED AND STRESSED ZIRCALOY-4

W. J. Babyak Jun. 1965 39 p refs

(Contract AT(11-1)-GEN-14)

(WAPD-T-1757) CFSTI: HC $2.00/MF $0.50

The habit planes for hydride precipitation in large grains of alpha zirconium and Zircaloy-4 were determined in specimens containing 161 and 136 ppM hydrogen, respectively. In zirconium, the hydride platelets precipitated on various pyramidal planes inclined to the basal plane at angles ranging from 10 to 50° and 75 to 90°. Hydrides were most frequent at inclinations of about 20 and 90°. In Zircaloy-4, the hydride habit was significantly different from that in zirconium. Hydride platelets were inclined to the basal plane at angles ranging from 5 to 25° with the predominant inclination equal to 12°; no platelets were found near the prism plane position. In both zirconium and Zircaloy-4, hydrides were principally, but not exclusively, parallel to {1011} type planes. When the Zircaloy-4 grains were subjected to tension stresses of 12,100 psi and 19,400 psi during hydride precipitation, the hydride habit was essentially unchanged except that precipitation favored those habit planes that were more nearly perpendicular to the stress direction. The stress-orientation effect increased with the magnitude of the stress. Author (NSA)

N66-33898# Southwest Research Inst., San Antonio, Tex.

INVESTIGATION OF THE EFFECTS OF FABRICATION ON THE PROPERTIES OF ERR PRESSURE VESSEL MATERIALS

J. Mc Donald and P. D. Watson 14 Mar. 1966 70 p /*ts* Topical Rept.-2

(Contract AT(11-1)-1228)

(SWRI-1228-4-17) CFSTI: HC $3.00/MF $0.75

Investigations were made to determine the effects of fabrication history on the nil ductility transition temperatures and the low cycle fatigue strengths of the Elk River reactor pressure vessel steels. The probable shell forming procedures for the pressure vessel were simulated for A302 Grade B steel by cold straining and warm (600°F) straining the material an amount equivalent to forming 3 inch thick material to a 7 foot diameter. Standard Charpy V-notch curves and standard S-N fatigue curves were developed for A302 Grade B steel for the various conditions. Low cycle fatigue curves and Charpy V-notch curves were determined for A105 Grade II steel trepanned from the ERR vessel flange and for A105 Grade II steel simulating the ERR pressure vessel nozzles. Author (NSA)

N66-33901# ACF Industries, Inc., Albuquerque, N. Mex.

METALLOGRAPHY OF 5% ALUMINUM–2.5% TIN TITANIUM ALLOY

J. C. Echer, J. E. Cooney, and A. J. Kish 11 Apr. 1966 17 p Presented at the Am. Soc. for Metals Sessions, WESTEC conf., Los Angeles, Mar. 1966

(Contract AT(29-1)-1352)

(ACF-17; ACF-412-286; Conf-660319-1) CFSTI: HC $1.00/MF $0.50

Metallographic interpretation of 5 Al–2.5 Sn titanium alloy must be conducted on surfaces that represent the true structure. Preparation techniques when controlled and properly executed can consistently ensure proper evaluation and interpretation. Examination at high optical magnifications and the use of polarized light illumination are of special assistance in obtaining dependable results. The specific structures observed in 5 Al–2.5 Sn titanium alloy depend upon the thermal fabrication history of the material. Equiaxed alpha and/or transformed alpha structures, produced by working-temperature exposure in the all-alpha or alpha-plus-beta range, exhibit

similar mechanical properties. These operations, when conducted at or above the beta transus, result in 5 Al–2.5 Sn titanium material with reduced strength levels and significantly lowered elongation and are to be avoided in the final fabrication stage. Author (NSA)

N66-33906# IIT Research Inst., Chicago, Ill.
YIELD PHENOMENA AND FRACTURE OF HYBRIDED ZIRCONIUM Quarterly Report, Jan. 1–Mar. 31, 1966
4 May 1966 25 p refs Joint U.S.—Euratom Res. and Develop. Program
(Contract AT(11-1)-578)
(IITRI-578P27-17; IITRI-B6035-17; EURAEC-1643) CFSTI: HC $1.00/MF $0.50

The temperature dependence (−200 to +200°C) of yield point in high-purity polycrystalline zirconium (~0.004 to 0.009 mm average grain diameter) was investigated. The results were correlated with the strain-hardening coefficient. Both yield point and strain-hardening coefficient showed a regular, continuous-type relationship with temperature over the entire grain size range. The results accentuated the first-order importance of fine grain size in yield point occurrence. Also, the strain-hardening rate was generally reduced by increasing temperature, and the effect was able to generate a yield point, when the grain size was permissive. The results bolster the credibility of the Johnston-Hahm model as a basis for explaining yield point occurrence in zirconium. NSA

N66-33953# Societe des Forges et Ateliers du Creusot (France).
BASIC STUDY ON A FEW EMBRITTLEMENT FORMS AFFECTING JOINTS WELDED ON HIGH RESISTANCE STEEL, AND ON MEANS OF IMPROVING THEIR MECHANICAL PROPERTIES Final Report
Brussels, EURATOM, May 1965 87 p
(Contract EURATOM-073-61-12-RDF)
(EUR-2368; EURAEC-1419) CFSTI: HC $3.00/MF $0.75

Results of efforts to produce a weldable low-alloy steel with high strength in the quenched or tempered states are reported. Approximately 70 experimental castings were made of a steel having the base composition of 0.15% C, 1% Cr, 1% Mn, 1% Ni, and 0.5% Mo plus an alloying element, or an element to control the austenitic grain size, or one of the common impurities. The effects of 19 different elements on the ductility of the base steel in the as-quenched or tempered states were investigated. NSA

N66-33976*# General Electric Co., Cincinnati, Ohio. Space Power and Propulsion Section.
ADVANCED REFRACTORY ALLOY CORROSION LOOP PROGRAM Quarterly Progress Report No. 4, Jan. 15–Apr. 15, 1966
R. W. Harrison, ed. 29 Apr. 1966 47 p
(Contract NAS3-6474)
(NASA-CR-72029) CFSTI: HC $2.00/MF $0.50 CSCL 11F

Results of work progress in a program directed toward fabricating, operating for 10,000 hrs, and evaluating a potassium corrosion test loop constructed of T-111 (Ta-8W-2H) alloy, are reported. Materials for evaluation in the turbine simulator include Mo-TZC and Cb-132M. Poor yields in the fabrication of the T-111 alloy have necessitated the melting of two additional ingots. Twenty nine lbs of lithium, which will be heated by direct resistance in a primary loop, were transferred to a hot trap. Analysis of the lithium after 126 hrs of hot trapping at 1500°F indicated an average nitrogen concentration of less than 8 ppm. Drawings of the alkali metal purification and handling system were submitted for approval. The results of a study to determine suitable welding conditions and post-weld annealing treatment for welds between Cb-1Zr alloy and T-111 alloy have indicated that the proposed joints between the Cb-1Zr surge tanks and T-111 fill lines of the Corrosion Loop I may be produced with manual TIG welding practices, if Cb-1Zr filler material and 2300–2400°F post weld annealing treatments are used. Other work relating to quality assurance and loop design are also discussed. L.S.

N66-33983*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ELECTRICAL RESISTIVITY AND CONDUCTIVITY OF TUNGSTEN-FIBER-REINFORCED COPPER COMPOSITES
David L. Mc Daniels Washington, NASA, Aug. 1966 19 p refs
(NASA-TN-D-3590) CFSTI: HC $1.00/MF $0.50 CSCL 11F

Tungsten-fiber-reinforced copper composites with fiber contents from 14 to 75 volume percent were made by liquid-phase infiltration techniques. Electrical-resistance measurements of the composites, unreinforced copper, and tungsten wires were made by using a Kelvin bridge. The resistivity of the composites was found to follow a hyperbolic function with fiber content, and the conductivity was found to follow a linear relation with fiber content. The ratio of ultimate tensile strength to resistivity and the ratio of ultimate tensile strength/density to resistivity of the composites were found to be superior to available standard conductors and to show promise for applications requiring high-strength electrical conductors. Author

N66-34000# Oak Ridge National Lab., Tenn.
ELECTRON BEAM FLOATING ZONE REFINING OF NIOBIUM
R. E. Reed Apr. 1966 44 p refs Presented Intern. Conf. on Electron and Ion Beam Sci. and Technol., New York Submitted for Publication
(Contract W-7405-ENG-26)
(ORNL-P-2108) CFSTI: HC $2.00/MF $0.50

The electron beam floating zone refining technique was evaluated as a purification method for niobium. Resistance ratios, extensive chemical analyses, and mechanical properties were used to assess the importance of various purification mechanisms in this technique for refining niobium. The results showed that with the exception of Ta and W, the metallic impurities in Nb are removed mostly by evaporation to levels less than 1 ppM by the electron beam floating zone technique. Other factors affecting the purification process are also discussed. NSA

N66-34040# Bristol Aerojet, Ltd., Banwell (England).
CHEMICAL CONTOURING OF HIGH TENSILE ALLOY STEEL SHEET MATERIALS AND COMPONENTS Interim Report
London, Min. of Aviation, Oct. 1960 79 p
(Contract KF/2/04/CB.25(A))
(S&T-Memo-20/60) CFSTI: HC $3.00/MF $0.75

Progress is reported in a program to develop etchants, masking materials, and methods of processing for 1% Cr–Mo-(S.A.E. 4130) steels, and to prepare a series of test panels to demonstrate the ability of the methods developed. Etch composition and etch resistant materials are described which will give satisfactory standards of rate of etch, line definition, depth control, and surface finish. In addition the effects of variability on material composition have been examined and the methods of controlling and replenishing the etch were determined. Test specimens were prepared for sustained loading tests to determine the effect of etching on the parent material. Other specimens were developed to demonstrate the practicability of the method of production. It is concluded that contour etching of 1% Cr–Mo steels is a practical process and offers considerable advantages for machining components which need a uniform reduction of thickness over a large proportion of their area. C.T.C.

N66-34055# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EXTRUSION STEEL AND FIELD OF THEIR APPLICATION

L. A. Poznyak and A. M. Rogalev 17 Mar. 1966 17 p refs Transl. into ENGLISH from Tr. Nauchn. Issled. Inst. Kuznechno-Pressovogo Mashinostr. (Moscow), no. 9, 1964 p 5–14 (FTD-TT-65-1417/1+2+4; TT-66-61402; AD-633664) CFSTI: HC $1.00/MF $0.50

The physical properties of alloy steels used in the U.S.S.R., the U.S.A., Sweden, England, and France are reviewed. Emphasis is given to the use of these steels in hot and cold extrusion, stamping, and metal forming operations. The use of manganese and chromium as replacements for nickel is discussed. D.T.

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N66-32890# Union Carbide Corp., Parma, Ohio. Carbon Products Div.

EFFECTS OF NEUTRON DAMAGE ON THE MECHANICAL PROPERTIES OF PYROLYTIC AND SINGLE-CRYSTAL GRAPHITE Quarterly Progress Report No. 4, Jan. 1–Mar. 31, 1966

J. T. Meers 15 Apr. 1966 12 p refs (Contract AT(40-1)-3237) (TID-22875) CFSTI: HC $1.00/MF $0.50

The production of compression-annealed pyrolytic graphite disks to be used for irradiation test specimens were produced. Values of C_{33} and C_{44} that were measured and calculated by several different methods were tabulated and compared with each other and with present results obtained. Reasonable agreement for C_{33} was found among the several methods of determining elastic constants, but the measured static values of C_{44} were 13 to 35 times smaller than the values calculated from the specific heat. NSA

N66-33102# United Kingdom Atomic Energy Authority, Risley (England). Reactor Group.

THE INFLUENCE OF PARTICLE SIZE DISTRIBUTION ON THE SINTERING OF CERAMIC POWDERS

A. G. Adwick and R. J. Warmer 8 Mar. 1966 22 p refs (TRG-1188(D))

One of the factors which can affect the sintered density of a ceramic is the pressing behaviour. This in turn is influenced by the particle size distribution. From an analysis of data on the packing of dense spheres and packing experiments on irregular shaped, coarse ceramic particles a series of curves have been derived. It is claimed that these curves can be used to relate the influence of particle size distribution on the packing efficiency and ultimately on the sintering behaviour of ceramic powders. The particle size distributions of $(U,Pu)O_2$ powders have been measured using the optical microscope. These distributions have been correlated with subsequent pressing and sintering by means of this analysis. Good agreement has been found. This analysis could prove useful in the study of sintering mechanisms to ensure the non-interference of technological factors. It also illustrates the need for effective particle size distribution measurement rather than true distribution in the understanding of powder behaviour. Author

N66-33157# Douglas Aircraft Co., Inc., Santa Monica, Calif. Astropower Lab.

CHAIN FOLDING MECHANISM AND CRYSTALLIZATION OF TFE-TEFLON

S. K. Asunmaa and R. G. Ingersoll [1965] 24 p refs Presented at the Western Regional Meeting of the Am. Chem. Soc., Los Angeles, 18–20 Nov. 1965 (Douglas Paper-3686)

Shock treated TFE-teflon samples were investigated by optical and transmission electron microscopy to aid in understanding the chain folding mechanism and crystallization of the samples. A photomicrograph and several electron micrographs of the patterns on the samples after various types of shock (compression, sintering, brittle fracturing, etc.) are depicted. The observations indicate that a chain folding occurs in the dimensional range of filaments and lamellae which are structural components of both spherulites and other well ordered regions in the bulk. It appears that the chain folding does not occur in one plane but follows the path of a polygonal screw line with an inclination of about 80°, and a pitch of about 20 Å. The fold length determines the filament width, some 250 Å and the thickness of smaller dimension, approximately 50 Å. The combination of two growth and folding directions at about 90° inclination causes the formation of a polygonal filament cross section. The splitting of filament aggregates to subunits in the longitudinal direction also explains the fact that the filaments have thus far been interpreted as preparation artifacts. L.S.

N66-33185*# Rensselaer Polytechnic Inst., Troy, N. Y. Interdisciplinary Materials Research Center.

IDENTIFICATION OF UNCOMMON NON-CRYSTALLINE SOLIDS AS "REAL" GLASSES

D. R. Secrist and J. D. Mackenzie [1964] 24 p refs Submitted for Publication (Grant NsG-100-60) (NASA-CR-59933) CFSTI: HC $1.00/MF $0.50 CSCL 11B

Non-crystalline solids can be prepared by many methods. For instance, besides the conventional cooling of a melt, condensation of the vapor or chemical deposition from solution at room temperature can also yield non-crystalline solids. In the former case, the resulting product is commonly referred to as a glass. To ascertain whether non-crystalline solids formed by some of the uncommon techniques are similar to the glass obtained by cooling the melt, an examination was made of the available pertinent physical properties of amorphous silica, alumina, magnesium fluoride, and a gold–silicon alloy. From a consideration of refractive index, density, infrared absorption and/or crystallization kinetics, it is concluded that these materials can be classified as "real" glasses. In some systems, it is shown that grossly different techniques yield essentially the same non-crystalline solid. Author

N66-33221# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

REPORTS OF THE ACADEMY OF SCIENCES OF THE UKRAINIAN SSR. Selected Articles

15 Mar. 1966 23 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Ukr. SSR (Kiev), no. 8, 1964 p 1035–1046 (FTD-TT-65-1038/1+2+3+4; TT-66-61132; AD-631851) CFSTI: HC $1.00/MF $0.50

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1. INFLUENCE OF RESIDUAL STRESSES ON THE FATIGUE STRENGTH OF STEEL WITH AN ACUTE STRESS CONCENTRATION I. I. Ishchenko and I. A. Malinovs'ka p 1–5 refs (See N66-33222 19-17)

2. EVALUATION OF THE STRENGTH OF FIBER-REINFORCED PLASTICS ON ORIENTED, CROSSED AND DISORIENTED BASES Ye. S. Umans'kiy p 6–13 refs (See N66-33223 19-18)

3. POLARIZATION OF LUMINESCENCE OF PURE AND IMPURE ANTHRACENE CRYSTALS B. L. Zima, G. S. Pekar, and O. M. Faydin p 14–20 refs (See N66-33224 19-18)

N66-33223# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EVALUATION OF THE STRENGTH OF FIBER-REINFORCED PLASTICS ON ORIENTED, CROSSED AND DISORIENTED BASES

Ye. S. Umans'kiy *In its* Rept. of the Acad. of Sci. of the Ukrain. SSR 15 Mar. 1966 p 6–13 refs (See N66-33221 19-17) CFSTI: HC $1.00/MF $0.50

The tension in a fiber-reinforced plastic model is examined for certain density distribution functions of fiber strength and fiber deviations from the direction in which the fiber combings are oriented. Theoretical formulas are derived that permit evaluation of the average strength of the material as a function of the type of base and the composition by weight of fibers and film. C.T.C.

N66-33224# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

POLARIZATION OF LUMINESCENCE OF PURE AND IMPURE ANTHRACENE CRYSTALS

B. L. Zima, G. S. Pekar, and O. M. Faydin *In its* Rept. of the Acad. of Sci. of the Ukrain. SSR 15 Mar. 1966 p 14–20 refs (See N66-33221 19-17) CFSTI: HC $1.00/MF $0.50

An investigation of anthracene crystals, with and without impurities, was made to distinguish the intrinsic and "defect" luminescences of the lattice. It was found that the first band of the intrinsic luminescence is split into two components at 90°K: $\nu_{\infty}^{b} \sim 25{,}140\ cm^{-1}$ and $\nu_{\infty}^{a} \sim 25{,}350\ cm^{-1}_{\infty}$. The appearance of these bands is due to the transition from the excitation bands of the b- and a-components. It was also found that the intensities of the intrinsic, defect and impurity (naphthacene) luminescence depends heavily on the temperature, and the causes of this dependence are considered in detail. C.T.C.

N66-33267# Watervliet Arsenal, N. Y. Benét Labs.

EFFECT OF FIBER GEOMETRY ON STRESS IN FIBER-REINFORCED COMPOSITE MATERIALS, PHASE 2

Thomas F. Mac Laughlin Apr. 1966 26 p ref

(WVT-6610; AD-633984) CFSTI: HC $2.00/MF $0.50

Six additional two-dimensional photoelastic models of fiber-reinforced composite material configurations were constructed and tested to study the effects on the shear stress distribution in an elastic matrix of (1) a gradually tapered fiber, (2) a fiber whose end was unbonded from the matrix, and (3) aligned fibers having various gap lengths between fiber ends. The tapered and unbonded fiber ends were found to produce somewhat higher peak stresses in the matrix than fiber end shape models tested in the phase 1 investigation. It made little difference whether the gap between aligned fiber ends was open, simulating a void resulting from a broken fiber, or filled with matrix material. Author (TAB)

N66-33304# Picatinny Arsenal, Dover, N. J. Plastics and Packaging Lab.

DILUTE SOLUTION PROPERTIES OF HIGH-MOLECULAR-WEIGHT POLY(ISOBUTYL METHACRYLATE). VII: EFFECT OF CENTRIFUGING ON VARIOUS PARAMETERS

Eleanor C. Schramm and Richard J. Valles Jun. 1966 68 p refs

(PA-TR-3305; AD-633470) CFSTI: HC $3.00/MF $0.75

Three samples of high-molecular-weight poly(isobutyl-methacrylate), designated 937, SW63/0082 and SW62/0298, were all found to be shear dependent. Sample SW62/0298, which has the highest molecular weight, readily dissolved in acetone and methyl ethyl ketone,. Both its weight average molecular weight and its intrinsic viscosity decreased as the centrifuging time increased. The number average molecular weight, determined by light scattering, seemed to remain-constant. Sample SW63/0082, with the next highest molecular weight, did not readily dissolve in acetone and methyl ethyl ketone, but again, the weight average molecular weight and the intrinsic viscosity decreased with centrifuging time, while the number average molecular weight remained constant. Sample 937 behaved somewhat differently. First, the intrinsic viscosity decreased slightly as the centrifuging time increased, but dropped slightly after four hours. The number average molecular weight remained constant. From light scattering measurements, the molecular weight, chain dimensions, and degree of polymerization for the weight, number, and Z averages were calculated. The number average molecular weight was determined by osmometry. Author (TAB)

N66-33378*# National Aeronautics and Space Administration, Washington, D. C.

[DEVELOPMENT OF THERMAL CONTROL COATINGS FOR SPACE VEHICLES]

Conrad P. Mook [1964] 7 p Presented at the Govt. Paint Symp., Ann. Meeting of the Natl. Paint, Varnish and Lacquer Assoc., Dallas, 11 Nov. 1964

(NASA-TM-X-54906) CFSTI: HC $1.00/MF $0.50 CSCL 20M

A research program dealing with the development of thermal control coatings for space vehicles is outlined. White paints were selected as basic material for their ability to reflect or absorb specific amounts of solar radiation, and to radiate heat at a known rate. A white paint, containing a combination of chemically pure zinc oxide and silicone evolved as a stable, reflecting coating for the upper hydrogen stage of the Saturn rocket. A coating containing carbon dioxide in epoxy degraded more rapidly during space application than in the ground based ultraviolet test chamber. A second titanium dioxide pigmented coating with a silicone binder seemed to perform somewhat better. G.G.

N66-33464*# DeBell and Richardson, Inc., Hazardville, Conn.

INITIATION OF FAILURE MECHANISMS IN GLASS–RESIN COMPOSITES

William J. Eakins Washington, NASA, Aug. 1966 70 p refs (Contract NASw-1100)

(NASA-CR-518) CFSTI: HC $3.00/MF $0.75 CSCL 11D

The state of the art in failure mechanisms of glass–resin composites is summarized, analyzed, and advanced, and a new theory is presented to correlate existing data. The value of flat-sided rectangular microtape as a strain-measuring device is considered and pictures of photoelastic studies on castings are presented. The effects on castings of shrinkage and external loading are also analyzed. Author

N66-33480# Monsanto Research Corp., Dayton, Ohio.

PHYSICAL AND RHEOLOGICAL PROPERTIES OF NITROSO RUBBERS Quarterly Report No. 10, 25 Sep.–24 Dec. 1965

George L. Ball, III, I. O. Salyer, and J. V. Pustinger 12 Jan. 1966 26 p refs

(Contract DA-19-129-AMC-151(N))

(MRB-4013Q10; AD-634143) CFSTI: HC $1.00/MF $0.50

Characterization of a trifluoronitrosomethane/tetrafluorethylene copolymer was continued. The CF_3NO/C_2F_4 co-

polymer was found to be adaptable to elution fractionation in a perfluorocyclic ether and a benzotrifluoride system. Even though 85% of the polymer eluted in a narrow viscosity range of 1.3 to 2.0, values of k and k' of the copolymer in FC-75 were confirmed to be 0.353 and 0.147, respectively. Thermal decomposition in air and in an inert gas was shown to be identical. The glass transition of the copolymer, as measured by DTA, is in the region of −41° C to −46° C with no more than 2° C difference between production lots. The white insoluble material present in the production lots was identified to be basic magnesium carbonate trihydrate. Author (TAB)

N66-33481# Monsanto Research Corp., Dayton, Ohio.
PHYSICAL AND RHEOLOGICAL PROPERTIES OF NITROSO RUBBERS Quarterly Report No. 11, 25 Dec. 1965–24 Mar. 1966
George L. Ball, III and I. O. Salyer 12 Apr. 1966 35 p refs
(Contract DA-19-129-AMC-151(N))
(MRB4013Q11; AD-634144) CFSTI: HC $2.00/MF $0.50

Characterization of the trifluoronitrosomethane/tetrafluorethylene copolymer was continued. The CF_3NO/C_2F_4 copolymer was found to be adaptable to elution fractionation in a perfluorocyclic ether and a benzotrifluoride solvent/nonsolvent system. A weight-viscosity distribution consisting of 25 fractions was obtained. A sample from which 25% insoluble gel was removed exhibited two dominant molecular weight regions of 2×10^5 and 4×10^6. The molecular weight of a fraction of the CF_3NO/C_2F_4 copolymer with a reduced viscosity of 1.37 in perfluorocyclic ether was determined by light scattering to be 2.1×10^6. An amine cured CF_3NO/C_2F_4 sample was swollen by fourteen solvents and chemicals, including water. No crystallinity was observed in the CF_3NO/C_2F_4 gum down to −80°C. Author (TAB)

N66-33509# Coating and Chemical Lab., Aberdeen Proving Ground, Md.
TROPICAL EXPOSURE OF FINISHING SYSTEMS FOR FERROUS METALS Progress Report
Melvin H. Sandler May 1966 70 p refs
(CCL-197; AD-634156) CFSTI: HC $2.00/MF $0.75

The report covers a study on the corrosion protection afforded to ferrous metal under tropical exposure conditions by 28 paint systems covered by military standard 171 "Finishing of Wood and Metal Surfaces". Also included were 4 systems using an experimental epoxy primer and one with an experimental thermoset acrylic top coat. The coatings were applied over solvent cleaned steel, as well as metal pretreatments conforming to types I, II, and III of federal specification TT-C-490 "Cleaning Methods and Pretreatment of Ferrous Surfaces for Organic Coatings". Test specimens were exposed in the Panama Canal Zone at breakwater, open field, and rain forest sites. Another set was exposed concurrently at Aberdeen Proving Ground. After 21 months exposure test data showed zinc phosphate conforming to TT-C-490 type I to be the most effective pretreatment and that with the exception of control of corrosion in scribed areas at seacoast sites, many of the current finishing systems will provide a high degree of corrosion protection under various types of climatic exposure. The exact duration of this protection remains to be determined by additional long term exposure of the more effective systems. Author (TAB)

N66-33860# General Electric Co., Philadelphia, Pa. Missile and Space Div.
THE VAPORIZATION OF PYROLYTIC GRAPHITE
P. D. Zavitsanos May 1966 39 p refs
(Contract AF 04(694)-222)
(R66SD31; AD-633611) CFSTI: HC $2.00/MF $0.50

The vaporization of pyrolytic graphite was studied by the Knudsen effusion and Langmuir free vaporization techniques using a microbalance and a time-of-flight mass spectrometer. vapor pressures were obtained in the temperature range 2417°K–2700°K for C, C_2 and C_3, respective heats of vaporization were calculated by the third-law method. Langmuir vaporization measurements were carried out in the temperature range 2250°K–2760°K. The ratios of vaporization coefficients obtained from mass spectroscopic measurements are: $\alpha_2/\alpha_1 = 2.1$, $\alpha_1/\alpha_3 = 10.6$. Use of vapor pressure data and vaporization rates was made to arrive at an overall vaporization coefficient equal to 0.095 and individual values of $\alpha_1 = 0.24$, $\alpha_2 = 0.50$ and $\alpha_3 = 0.023$. Author (TAB)

N66-34014# Princeton Univ., N. J. Frick Chemical Lab.
PROPERTIES OF LINEAR ELASTOMERIC POLYURETHANES
Stuart L. Cooper and Arthur V. Tobolsky May 1966 20 p refs
(Contract Nonr-1858(07))
(RLT-92; AD-633787) CFSTI: HC $1.00/MF $0.50

The viscoelastic properties of some polyester–urethanes are compared with the properties of other polymers. The behavior observed is anomalous in that these polyurethanes exhibit an unusually high value of modulus well above their T_g, unaccounted for by either crosslinking or crystallinity. Various experiments including incorporation of plasticizers of widely varying chemical composition have suggested interpretation of the system as a block copolymer, each block having its own T_g. Each of the two types of blocks seems to associate with similar blocks from other molecules.
Author (TAB)

N66-34018# Felters Co., Boston, Mass.
BALLISTIC RESISTANCE OF NEEDLE-PUNCHED NYLON FELTS Final Report, Oct. 1963–Feb. 1965
Richard C. Keith Natick, Mass., Army Natick Labs., May 1966 53 p *Its* Tech. Rept.-66-39-CM
(Contract DA-19-129-AMC-204(N))
(TS-137; AD-633881) CFSTI: HC $3.00/MF $0.50

Felts made from high tenacity nylon 6.6 (industrial quality), bright, 6-denier filament, three-inch staple, crimpset fiber were found to be the most satisfactory in ballistic resistance, uniformity, and ease of processing among the group studied. Batts that were cross-laid proved to be superior to the parallel-laid batts and equal to a combination of straight- and cross-laid batts. The best felt, from the standpoint of both ballistic resistance and dimensional stability, was produced by needling 4-ounce batts alternately on each side, with 277 penetrations per square inch and a half-inch needle-penetration, followed by flat-bed pressing (using 0.29-in spacer bars at 310°F for 2-1/2 min) to attain the desired thickness. Producer's virgin waste of the same high tenacity nylon 6.6 appeared to be promising although the test results were inconclusive. TAB

N66-34020# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
GRAFTED COPOLYMERS OF CELLULOSE WITH CERTAIN VINYL MONOMERS
U. Azizov, Kh. U. Usmanov, and M. U. Sadykov 21 Jan. 1966 13 p refs Transl. into ENGLISH from Akad. Nauk SSR, Inst. Khim. Polimerov. Khim. i Fiziko-Khim. Prirodn. i Sintetich. (Polimerov), No. 1, 1962 p 23–28
(FTD-TT-65-1481/1+2+4; AD-633816) CFSTI: HC $1.00/MF $0.50

Grafted copolymers of cellulose with methylacrylate, methylmethacrylate, and vinylacetate were obtained under the action of gamma rays. The nature of the polymer and its solvent has an influence on the formation of grafted copolymers of

cellulose with different monomers. The grafting to cellulose of the indicated monomers does not bring about a notable change in the tensile strength of the fiber, but leads to a lessening of the hydrophily of the grafted copolymers.
Author (TAB)

N66-34058# Naval Research Lab., Washington, D. C.
INFRARED SPECTRA OF PLASTICS AND RESINS. PART 2: MATERIALS DEVELOPED SINCE 1954
Interim Report
Suzanne S. Stimler and R. E. Kagarise 23 May 1966 37 p refs
(NRL-6392; AD-634427) CFSTI: HC $2.00/MF $0.50

Sixty-one polymeric materials, most of which have been developed since 1954, were studied. Infrared transmittance curves in the region from 4000 to 400/cm $^{-1}$ are presented for 46 of these. Curves for the 15 remaining ones are not shown, but are compared to those in each group that are identical or similar to them. Where possible, the spectra are discussed briefly in terms of the structural groups present. Methods based on infrared absorbance ratios are used to estimate the densities of some polyethylene polymers and some acrylonitrile butadiene styrene (ABS) terpolymers. In the case of polyethylene, these ratios can also be related to the crystalline content of the polymer. The procedure for identification of unknown spectra given in 'Infrared Spectra of Plastics and Resins,' Part 1, PB-111 438, is extended to include the newer polymeric materials. Author (TAB)

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N66-32971# Princeton Univ., N. J. Plasma Physics Lab.
ASYMPTOTOLOGY
M. Kruskal *In* Intern. Atomic Energy Agency Plasma Phys. 1965 p 373-387 refs Submitted for Publication (See N66-32966 19-25) CFSTI: HC $9.79/MF $3.25
(Contract AT(30-1)-1238)

Asymptotology is defined as the art of dealing with applied mathematical systems in limiting cases, and the concept of an applied mathematical system is explained as the mathematical description of a physical system in which the variables expressing the state of the system are complete. Asymptotology is considered important as the examination of limiting cases seems to be the only effective method of proceeding with the analysis of complicated problems when exact mathematical methods are not available. It is also found of value in obtaining qualitative information about the behavior of a system and its solutions, and for obtaining quantitative (numerical) results. Several examples, showing the applications of these principles, are cited. M.G.J.

N66-32985# United Kingdom Atomic Energy Authority, Culham (England). Research Group.
SOME TECHNIQUES FOR RATIONAL INTERPOLATION
F. M. Larkin Mar. 1966 31 p refs Submitted for Publication
(CLM-P-101) CFSTI: HC $2.00/MF $0.50

Simplified forms of Stoer's rational interpolation algorithms are presented as special cases of a generalisation of the Neville-Aitken method. These algorithms offer convenient means for effecting rational interpolation in a given set of data points, either numerically or analytically. Author

N66-33148# Texas Univ., Austin. Computation Center.
FINDING EIGENVALUES WITH LAGUERRE ITERATIONS
Robert Mark Hansard (M.S. Thesis) May 1965 105 p refs
(Grants NSF GP-217; DA-ARO(D)-31-124-G388)
(TNN-45; AROD-3772:12; AD-617597) CFSTI: HC $4.00/MF $0.75

The use of Laguerre iterations for finding eigenvalues of matrices is considered. The algorithm discussed here is designed for the calculation of the eigenvalues of real square matrices of orders up to 100. The method is applicable to complex matrices also. The method consists of reducing the given matrix A to Hessenberg form H by similarity transformations and then conducting an iterative search for the eigenvalues of H using the method of Laguerre. Author (TAB)

N66-33235# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
COMPUTATIONAL METHODS FOR DETERMINING LOWER BOUNDS FOR EIGENVALUES OF OPERATORS IN HILBERT SPACE
David W. Fox and Werner C. Rheinboldt (Maryland Univ.) Mar. 1966 75 p refs
(Contracts NOw-62-0604-C; Grant DA-ARO(D)-31-124-G-563)
(TG-810; AD-633625) CFSTI: HC $3.00/MF $0.75

This report presents a survey of computational methods for determining lower bounds for eigenvalues of semi-bounded, selfadjoint operators in Hilbert space, in particular, of many operators associated with boundary value problems for ordinary and partial differential equations of mathematical physics and engineering. Author (TAB)

N66-33264# California Univ., Los Angeles. Dept. of Mathematics.
THE CLASS O_{AD} OF RIEMANNIAN 2-SPACES
Norma Lee Breazeal (Ph.D. Thesis) Jun. 1966 51 p refs *Its* Tech. Rept.-41
(Grant DA-ARO(D)-31-134-G742
(AROD-1517-92; AD-633691) CFSTI: HC $3.00/MF $0.50

This dissertation is primarily concerned with the development of tests to determine whether a given 2-dimensional Riemannian space M belongs to the class O_{AD} (to be specified), and the construction of an important class of covering 2-spaces with this property. An investigationis first made of the modulus function h and of a related multiple-valued function h^*, the conjugate of H. It is shown in particular that every branch h of h^* is harmonic and that the level lines of h and h^* form a system of coordinates which are orthogonal except on a set of measure zero. Let AD(M) be the class of harmonic functions on M with a finite Dirichlet integral on M and with vanishing flux across every 1-cycle. If the class AD(M) consists of constants then M belongs to the class O_{AD}. A modular criterion is established to determine whether a given M belongs to O_{AD}. This modular test is used to develop a second test in terms of a conformal metric. Moreover, a relation between the modulus and extremal length is established and used to determine a third test which uses regular chains. Finally abelian type covering spaces of a compact 2-dimensional Riemannian space are constructed and, using the regular chain test, shown to belong to the degenerate class O_{AD}.
Author (TAB)

N66-33294# Army Missile Command, Huntsville, Ala. Translation Branch.
CONCERNING THE INVERTIBILITY OF THE LYAPUNOV'S THEOREM OF ASYMPTOTIC STABILITY
I. G. Malkin Mar. 1966 19 p refs Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), v. 18, 1954 p 129-138
(RSIC-526; TT-66-61388; AD-633586) CFSTI: HC $1.00/MF $0.50

This paper sets forth the necessary and adequate requirements for the existence of a Lyapunov function that will satisfy all conditions required by his theorem of asymptotic stability.
Author (TAB)

N66-33358# Naval Ordnance Test Station, China Lake, Calif.
INTERVAL ESTIMATES FOR RATIOS OF REGRESSION PARAMETERS
Frank C. Reed May 1966 29 p refs
(NOTS-TP-4097; AD-633946) CFSTI: HC $2.00/MF $0.50

Two extensions of the classical estimation of a ratio of two regression parameters are considered. The first extension is concerned with the case in which a number of experiments are performed and each experiment involves a regression function with different regression parameters and different unknown variances of observation. With such assumptions it may turn out that even though the regression parameters for each experiment are different, the ratios of two specified regression parameters for each experiment are the same for all experiments. The first extension provides a method of combining the results of all experiments to obtain an internal estimate for this unknown ratio. The second extension provides a solution to the problem of obtaining simultaneous interval estimates for more than one ration of regression parameters when a single experiment is performed. Author (TAB)

N66-33363# Army Missile Command, Huntsville, Ala. Translation Branch.
CONDITIONS OF ASYMPTOTIC STABILITY IN THE CASE OF UNSTABLE MOTION AND AN EVALUATION OF THE RATE OF DECREASE OF THE GENERAL SOLUTION
V. I. Zubov Mar. 1966 34 p refs Transl. into ENGLISH from Vestn. Leningr. Univ. (Leningrad), no. 1, 1957 p 110-129
(RSIC-529; AD-633662) CFSTI: HC $2.00/MF $0.50

Discussed are conditions for uniform stability and nonuniform asymptotic stability as well as the necessary and sufficient conditions for the asymptotic stability of the zeroth solution of a determined quality. Investigated are specific systems of differential equations by means of specific functions. Author (TAB)

N66-33401*# Stanford Univ., Calif. Dept. of Statistics.
UNLIMITED SIMULTANEOUS DISCRIMINATION INTERVALS IN REGRESSION Technical Report No. 90
G. J. Lieberman, R. G. Miller, Jr., and M. A. Hamilton 29 Jul. 1966 29 p refs Sponsored in part by NASA
(Contract Nonr-225(53))
(NASA-CR-77022) CFSTI: HC $2.00/MF $0.50 CSCL 12A

The discrimination problem can be described as having n pairs of values from which the regression line $\alpha + \beta x$ is estimated. The K additional observations $Y_1^*, Y_2^*, \ldots, Y_K^*$ for which the corresponding independent variable values $x_1^*, x_2^*, \ldots, x_K^*$ are unknown are observed. These values of x are bracketed by means of simultaneous confidence intervals. A solution to this problem of arbitrary K is given in terms of unlimited simultaneous discrimination intervals. Unlimited simultaneous discrimination intervals $[\underline{D}_{\gamma}(P), \overline{D}_{\gamma}(P)]$ are presented which are based upon the same estimated linear regression and which have the property that at least 100P per cent of the discrimination intervals will contain the true x's with confidence $1 - \alpha$. Thus if for a single regression line one asserts that at least 100P per cent of the discrimination intervals will contain the correct x's, and similar statements are made repeatedly for different regression lines, then for $100(1 - \alpha)$ per cent of the different regression lines the statements will be correct. For the other fraction (100α per cent) the percentage of discrimination intervals enclosing their true x's may be greater or less than 100P per cent for each line. Two techniques for obtaining unlimited simultaneous discrimination intervals are given. The first method is a procedure which is obtained through the Bonferroni inequality, while the second technique is based upon an idea presented in a paper by Lieberman and Miller (1963). A numerical example is analyzed. A general discussion and comparison of the two methods for finding unlimited simultaneous discrimination intervals is given. Author

N66-33402*# Kent State Univ., Ohio. Dept. of Mathematics.
ON DIRECTED GRAPHS AND RELATED TOPOLOGICAL SPACES Technical Report No. 2
Thomas J. Ahlborn 30 Sep. 1964 44 p refs
(Grant NsG-568)
(NASA-CR-77019) CFSTI: HC $2.00/MF $0.50 CSCL 12A

In this report, certain tie-ups between the theory of directed graphs and point-set topology are investigated. With each directed graph $\Gamma(A,E)$ on an arbitrary set A, we associate a unique topological space $(A,\mathfrak{I})$ by defining a set $\underline{a} \subseteq A$ to be open if there does not exist an edge in $\Gamma(A,E)$ from set $(A - \underline{a})$ to set $\underline{a}$; each such topology is shown to have the property of completely additive closure. We obtain several theorems relating connectedness and accessibility properties of a directed graph to properties of the topology determined by that directed graph. It is found that the connectedness of a directed graph is, in a certain sense, consistent with the topological connectedness of the topological space determined by that directed graph. We further investigate these topologies in terms of the closure, kernel, and core operators. Author

N66-33438*# Brown Univ., Providence, R. I. Center for Dynamical Systems.
ASYMPTOTIC STABILITY OF SAMPLED NONLINEAR SYSTEMS WITH VARIABLE SAMPLING PERIODS—A BIONIC APPLICATION Discussion
J. J. Hurt and J. P. La Salle [1966] 8 p refs
(Grant NGR-40-002-015)
(NASA-CR-77045) CFSTI: HC $1.00/MF $0.50 CSCL 12A

Vidal and Laurent developed conditions for the stability of a certain class of nonlinear sampled systems. These same conditions can be easily developed with more generality and rigor through the use of a more recent form of Liapunov's second method. This paper presents the relevant theorem and its corollary and illustrates how the criteria of Vidal and Laurent can be developed using Liapunov functions. R.N.A.

N66-33462*# Pennsylvania State Univ., University Park.
ROOT LOCUS DIAGRAMS BY DIGITAL COMPUTER
Allan M. Krall and Robert Fornaro Washington, NASA, Aug. 1966 36 p refs
(Grant NGR-39-009-041)
(NASA-CR-555) CFSTI: HC $2.00/MF $0.50 CSCL 12A

Adaption of the root locus method with delay to programming on the IBM 7074 digital computer is described. The root locus method describes how to construct the graph of the roots of the characteristic equation as one parameter varies, which enables the designer to choose the positions of the roots with some freedom, possibly achieving stability. The root locus method is formulated and its adaptation to programming is discussed and illustrated by flow charts. The parameters necessary for execution of the program are given and the program itself is included. L.E.W.

N66-33518# Brown Univ., Providence, R. I.
POLYNOMIAL APPROXIMATIONS TO FUNCTIONALS IN THE THEORY OF MATERIALS WITH MEMORY Technical Report No. 13
John S. Lew May 1966 20 p refs
(Contract Nonr-562(40))
(NONR-562(40)/13; AD-634489) CFSTI: HC $1.00/MF $0.50

For a material with memory, the functional ϕ which relates the stress to the strain history may sometimes be use-

fully approximated by a polynomial in the elements of a space L of linear functionals on the space F of strain histories. This paper extends an earlier result of Chacon and Rivlin to prove such approximations possible on all bounded sets in the given topology for F, for all functionals ϕ uniformly continuous in the weak topology on F defined by L. Author (TAB)

N66-33520# California Univ., Berkeley. Operations Research Center.
NOTES ON OPERATIONS RESEARCH—5
Apr. 1966 54 p refs
(Contracts Nonr-222(83); DA-31-124-ARO(D)-331; Grant NSF GP-4593)
(ORC-66-13; AD-634329) CFSTI: HC $3.00/MF $0.50

Contents: articles: remarks about random sampling from beta and gamma distributions, R. N. Kaul: a short proof of Hu's assembly line theorem, by Lars-Chr. Lorentzen: proof of a theorem from the theory of complementary solutions of linear systems, by Lars-Chr. Lorentzen: netowrks and assembly line balancing, by Shishir Kumar Mukherjee: summary of Klee's results on bounding the number of simplex cycles, by Bennett Fox; review: cycling in the transportation problem, by B. J. Gassner; research problems, by George B. Dantzig; abstracts: selected thesis abstracts in operations research. TAB

N66-33637*# National Aeronatuics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
EXPLICIT RUNGE-KUTTA INTEGRATION
Lyle R. Dickey 28 Jul. 1966 13 p refs
(NASA-TM-X-53495) CFSTI: HC $1.00/MF $0.50

A fourth order Runge-Kutta method is applied to a system of linear differential equations. The solution over one time step is obtained explicity as a function of initial conditions and the forcing function evaluated at the initial time, the final time, and the midpoint. Successive applications of this result can be employed to obtain an explicit solution for a number of time points which can later be used to rapidly determine solutions for a large number of different sets of initial conditions and forcing functions. Author

N66-33568 Stanford Univ., Calif. Graduate School of Business.
A FINITE RENEWAL ALGORITHM FOR THE KNAPSACK AND TURNPIKE MODELS
Jeremy F. Shapiro and Harvey M. Wagner Nov. 1965 29 p refs
(Grant NSF G-24064)
(TR-14; PB-168904) CFSTI: HC $2.00/MF $0.50

An exploration is made of the connection between two operations research problems. The first model is described as maximize

$$\sum_{j=1}^{n} F_j(x_j)$$

subject to

$$\sum_{j=1}^{n} H_j(x_j) = L \ (= \text{integer}),$$

x_j non-negative integer, where each $F_j(X_j)$ is real valued, each $H_j(X_j)$ is a non-negative, non-decreasing, integer valued function, and $H_j(0) = 0$. The second model, which is of the renewal type, is formulated in terms of a dynamic programming recursion

$$G(L) = \underset{j=1,2,\ldots,n}{\text{maximum}} \ [f_j + \alpha^{h_j} G(L-h_j)]$$

with $h_j \leq L$ where $0 \leq \alpha \leq 1$, each f_j is a finite real number, each h_j a non-negative integer, and $h_1 = 1$. C.T.C.

N66-33573*# Bellcomm, Inc., Washington, D. C.
AN APPLICATION OF GROUP THEORY TO THE NUMERICAL INTEGRATION OF THE EQUATIONS OF MOTION BY A CONSERVATIVE DYNAMICAL SYSTEM
H. A. Helm 1 Sep. 1965 31 p refs
(Contract NASw-417)
(NASA-CR-76940; TM-65-1032-3) CFSTI: HC $2.00/MF $0.50

Group theoretical concepts are applied to the numerical integration of the equations of motion of a conservative dynamical system. Rather than obtain the solution by one of the standard methods of numerical analysis a transformation group is derived which maps the state of system at time t_i onto the state of the system at time $t_{i+1} = t_i + \Delta t$. Because of the group property in conservative systems, time is reversable. That is, the readily obtained inverse to the transformation, maps the state of the system at time t_{i+1} onto the state at time $t_i = t_{i+1} - \Delta t$ so that given a desired terminal condition for a trajectory the problem may be worked backwards to determine the required initial conditions. Truncation error is arbitrary so that the programmer may trade off function evaluation for step size to optimize computer running time. This memoranda is a preliminary report and the development is heuristic. A brief review of classical Hamiltonian theory is included. Author

N66-33597# RAND Corp., Santa Monica, Calif.
THE EXISTENCE OF PURE, STATIONARY OPTIMAL POLICIES FOR A CLASS OF MARKOV RENEWAL PROGRAMS
Bennet Fox Jun. 1966 8 p refs Submitted for Publication
(P-3378; AD-634084) CFSTI: HC $1.00/MF $0.50

Assuming that the history of a process does not effect the probability of direct transition from one state to another, that it does not effect the transition time distribution, and that it does not effect the loss incurred, a series of inequalities are stated which jointly imply the existence of a pure, stationary policy that minimizes expected cost per unit time. The main result of the theorem is an exhibit of conditions which imply that a pure, stationary optimal policy for the average cost case exists. D.T.

N66-33600# Brown Univ., Providence, R. I.
THE GENERALIZED CAYLEY-HAMILTON THEOREM IN n DIMENSIONS Technical Report No. 6
John S. Lew 4 Mar. 1965 12 p refs
(Contracts Nonr-562(40); ARPA SD-86)
(Nonr-562(40)/6; ARPA-AM-20; AD-633718) CFSTI: HC $1.00/MF $0.50

For any positive integer n, this paper derives the explicit form the identity in n matrices, each nXn, which is obtained by complete polarization of the usual Cayley/Hamilton theorem, and which is used repeatedly, for n = 2 or 3, in the determination of an integrity basis for symmetric tensors. Author (TAB)

N66-33680*# National Aeronautics and Space Administration. Washington, D. C.

ONE NON-LINEAR PROBLEM WITH A FREE BOUNDARY [OB ODNOY NELINEYNOY ZADACHE SO SVOBODNOY GRANITSEY]

I. I. Danilyuk Jun. 1966 13 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 162, no. 5, 1965 p 979–982

(NASA-TT-F-10221) CFSTI: HC $1.00/MF $0.50 CSCL 12A

Let G_z denote the region between the unit circle Γ and the free boundary γ. Find the function ψ so that ψ is harmonic within G_z and continuous on $G_z + \Gamma + \gamma$; $\psi = 0$ on Γ; ψ = const on γ; grad $\psi = Q$ on γ, with $Q(x, y)$ given as a circular or periodic junction. Author

N66-33785# California Univ., Los Angeles. Dept. of Engineering.

RECURSIVE CHEBYCHEV APPROXIMATION FOR DISCRETE PIECEWISE CONTINUOUS FUNCTIONS

Mohinder Singh Grewal Dec. 1965 55 p refs

(Contract AF 04(694)-826)

(Rept.-65-51; AD-482202)

Problems of prediction and filtering, which are important parts of control problems, can be treated as those of data fitting. The above problem is known as Chebychev approximation problem, when the absolute deviation is used as the measure of goodness of approximation. The technique to be explored, the Chebychev approximation, spreads the error over the entire interval. This thesis gives a recursive algorithm for the Chebychev approximation problem. This algorithm is then applied to optimal control of the entry problem, and the results of a digital computer computation are presented. The control is approximated by a continuous function over the entire interval and with piecewise continuous functions. The results are compared with the exact simulation. The results show that the piecewise continuous approximation is as good as continuous approximation over entire interval. So piecewise continuous approximation can be applied to bounded controls very easily. TAB

N66-33804 New Mexico State Univ., University Park. Dept. of Mathematics.

REPEATED INDEPENDENT TRIALS AND A CLASS OF DICE PROBLEMS

Edward D. Thorp [1961] 10 p refs

(Grant NSF G-25058)

(PB-168925)

A numerical solution to a class of dice problems is presented, in relation to the probability theory, in which repeated independent dice rolls are made and the probability data recorded. Formulations evolved illustrate the stochastic independence of events in certain trials, and the probability of eventual failure. Tabular data depict electronic computer solutions to problems, and the ease of machine calculation is noted. R.LI.

N66-33828# System Development Corp., Santa Monica, Calif.

MATRIX MANIPULATIONS BY COMPUTER: COMPUTATION OF FUNCTIONS OF A MATRIX

John Staudhammer 27 May 1966 38 p refs

(TM-2891/002/00; AD-633927) CFSTI: HC $2.00/MF $0.50

A program is described for the calculation of functions of numeric matrices. The methods of Krylov and Leverrier are used. The program presented calculates the characteristic equation of the matrix by Krylov's method, then obtains the eigenvalues by finding the roots of this equation. In the enclosed program the method of Muller is used, although any other root-solving routine would work also. Calculations for complex eigenvalues are terminated, since the required complex arithemetic is quite unwieldy and is not included in this program. Such calculations could easily be carried out in Fortran IV. For real eigenvalues the function is calculated using the Cayley-Hamilton theorem for finding the coefficients of the finite expansion of the function in powers of the given matrix. Repeated eigenvalues are also handled by this program, although the resultant numerical accuracy is not very good. The program is not optimized in any way, it is intended for teaching purposes and therefore prints copious intermediate results. A Fortran II program, checked on a Philco 2000 ALTAC III compiler, is given here. Author (TAB)

N66-33861 Illinois Univ., Urbana.

SUCCESSIVE CONDITIONAL EXPECTATIONS OF AN INTEGRABLE FUNCTION

D. L. Burkholder [1964] 14 p refs Prepared in Cooperation with Calif. Univ., Berkeley

(Grant NSF G-19667)

(PB-168916)

It was previously shown that if $[T_n]$ is a sequence of conditional expectation operators, $Sn = T_0T_1 \ldots T_{n-1}T_nT_{n-1} \ldots T_1T_0$, and X is a random variable such that $E(|X| \log^+ |X|) < \infty$, then the sequence $[S_nX]$ converges almost everywhere to an integrable function. Here it is shown that this result fails to hold if $E(|X| \log^+ |X|) < \infty$ is replaced by $E|X| < \infty$. Moreover, it is shown that $E(|X| \log^+ |X|) < \infty$ is a necessary condition for the almost everywhere convergence of $[S_nX]$ for every $[T_n]$ if the underlying probability space (Ω, α, P) is rich enough to support independent identically distributed random variables $X_1, X_2, \ldots$ such that $X_1 = X$. C.T.C.

N66-34016# RAND Corp., Santa Monica, Calif.

LOCAL BEHAVIOR OF STATIONARY GAUSSIAN PROCESSES

Michael B. Marcus Jun. 1966 41 p refs

(P-3375; AD-633988) CFSTI: HC $2.00/MF $0.50

The local behavior of a wide class of separable, stationary Gaussian processes with continuous sample paths is described. The processes considered were restricted to those with covariances that satisfy smoothness conditions even stronger than convexity. Analogs were sought to the well-known results for Brownian motion, the law of the iterated logarithm, and Paul Levy's uniform Hoelder condition. Upper and lower bounds for the Gaussian processes were determined and the relations between the upper and lower bounds are discussed. L.E.W.

N66-34075*# Kent State Univ., Ohio. Dept. of Mathematics.

ON DIAMETERS OF GRAPHS AND DIGRAPHS

Louis J. O'Korn (M.A. Thesis) Aug. 1966 38 p refs /ts Tech. Rept.-13

(Grant NsG-588)

(NASA-CR-77084) CFSTI: HC $2.00/MF $0.50 CSCL 12A

The extremal properties were investigated of the elongation diameter of those connected graphs which have a fixed number of edges and vertices and of the diameter of those finite strongly connected digraphs (directed graphs) which have a fixed number of diedges and vertices. The problem considered was the construction of graphs and digraphs in which the elongation diameter or the diameter, as the case may be, is a minimum. Basic definitions and relevant notations from the theory of graphs and directed graphs are given, along with some pertinent results from the theory of incidence matrices. A class of graphs which is a subset of the class of all connected graphs and whose elements have the property of minimum elongation diameter is introduced. Finally previous results are summarized for the construction of graphs and digraphs. It is noted that while a complete solution to the construction

was not found, some interesting side results were obtained relating to the diameter of the digraph and the rank of incidence matrix isomorphic to the digraph. D.T.

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N66-33119# Canada. Dept. of Transport, Toronto. Meteorological Branch.

THE IDENTIFICATION AND MOVEMENT OF MESO-SCALE THUNDERSTORM SYSTEMS

E. C. Jarvis 14 Dec. 1965 28 p refs

(CIR-4346; TEC-591) CFSTI: HC $2.00/MF $0.50

A method of using hourly weather reports to identify meso-scale thunderstorm systems according to Pedgley's model is presented, and the movement of meso-systems in relation to the wind field in the middle troposphere, and the low-level moisture pattern, is discussed. Examples are used to show that the technique can identify regions where convective cells are likely to be present. Short-range forecasts of these regions of convective cloud, using developed statistical relationships or extrapolation principles, were found unsatisfactory for operational purposes. Author

N66-33161# Chicago Univ., Ill. Dept. of Geophysical Sciences.

FEATURES AND MOTIONS OF RADAR ECHOES ON PALM SUNDAY, 1965: CHAPTER V OF A COMPREHENSIVE STUDY OF THE PALM SUNDAY TORNADOES, 1965

Dorthy L. Bradbury and Tetsuya Fujita Jun. 1966 29 p refs

(Grant CNB-WBG-70)

(SMRP-51)

An abundant amount of radar data gathered on Palm Sunday 1965 has been used to make a detailed study of the development of the tornado producing echoes. The echoes were matched with damage paths and reported time of occurrences, and then designated as separate tornado families. The rate and direction of motion of individual echoes were determined by plotting time–space positions of the echoes at 10 minute intervals from several radar stations. A composite of radar photographs from three stations at intervals of from two minutes to ten minutes was used to show the growth rate and change in features of severe storm echoes. Using the combined radar echoes from all available stations to supplement pressure, wind and dewpoint data, a detailed synoptic analysis was made for the period 11 through 23 CST. It was shown that the severe storm activity was associated with the advance of a dry cold front. Author

N66-33204# France. Direction de la Meteorologie Nationale, Paris.

THE CLIMATE OF GUADELOUPE [LE CLIMATE DE LA GUADELOUPE]

A. Theveneau Nov. 1965 108 p refs In FRENCH *Its* Monographies de la Meteorol. Natl., No. 50

(CFSTI: HC $4.00/MF $0.75

Seasonal variations in rain gauge, atmospheric circulation, and climate are discussed. Statistics are recorded on annual and daily cycles of precipitation distribution; climatic structure in relation to cyclone frequency; and temperature, surface winds, and normal seasonal evolution of atmospheric pressure. Data are also tabulated for rainfall rates at certain geographic locations; average, normal, minimum and maximum temperatures; daily and monthly average evaporation rates; humidity and water vapor measurements; wind velocity, and daily extremes for insolation; strong winds, and storms.

Transl. by R.Ll.

N66-33205# Canada. Dept. of Transport, Toronto. Meteorological Branch.

VERIFICATION OF OBJECTIVE FORECASTS AT THE CENTRAL ANALYSIS OFFICE OF THE METEOROLOGICAL SERVICE OF CANADA

D. L. Holyoke 22 Oct. 1965 32 p ref

(CIR-4320; TEC-585) CFSTI: HC $2.00/MF $0.50

At the Central Analysis Office of the Meteorological Service of Canada, a digital computer is used to verify certain types of objective weather forecasts on a routine (twice daily) basis. A description of the more or less standard verification methods employed is given, as well as a rationale justifying these methods. Some discussion of the inter-relations between the various statistical parameters computed is included in an appendix. A six months' summary of verification results for an operational 500-mb barotropic model, as well as a 300-mb and 200-mb operational statistical model (Derived Fields), is presented. Author

N66-33268# Thornthwaite (C. W.) Associates, Centerton, N. J. Lab. of Climatology.

DEVELOPMENTS IN METEOROLOGICAL SENSORS AND MEASURING TECHNIQUES TO 150,000 FEET, 1965 Final Report

John R. Mather, Ed. Apr. 1966 171 p refs

(Contract AD-28-043-AMC-01248(E))

(ECOM-01248-F; AD-633918) CFSTI: HC $5.00/MF $1.00

Results of a continuing survey of recent developments in meteorological sensors and measuring techniques for measuring temperature, wind, humidity, radiation (solar and terrestrial), density, pressure, and ozone from the surface up to 150,000 feet are presented as an annotated bibliography of 230 items plus an analysis of the current state-of-the-art and a discussion of promising developments. The report also includes an introduction on the meteorological characteristics and therefore instrumental needs in the stratosphere. The text includes 104 references. Author (TAB)

N66-33271# Army Electronic Proving Ground, Fort Huachuca, Ariz. Research Div.

NUMERICAL SOLUTION OF THE TRANSPORT AND ENERGY EQUATIONS IN THE PLANETARY BOUNDARY LAYER

William D. Ohmstede Apr. 1966 156 p refs

(ECOM-6020; AD-633694) CFSTI: HC $5.00/MF $1.00

This report presents the development of an algorithm for the approximate prediction of the physical behavior of the planetary boundary layer. For the sake of brevity, the problem is restricted to one which displays most of the essential features involved. By means of various approximations, the problem is stated in mathematical terms. The behavior of the planetary boundary layer is described by a system of nonlinear partial differential equations of the parabolic type, and boundary conditions at the earth's surface are developed in terms of the energy balance principle, through a priori analysis. It is inferred that the problem is well-posed. Various finite-difference operators are proposed and shown to be consistent with the differential operators. The boundedness and computational stability of the solutions of the finite-difference operators are discussed. It is concluded that the pure implicit nonlinear operator is the most satisfactory for the development of the algorithm. The algorithm is developed in detail

and several solutions are presented to illustrate the results obtainable from it. Author (TAB)

N66-33281# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
ATHENA FLIGHT NUMBER 041 (12 MAY 1966) Meteorological Data Report
Harold M. Richart Fort Monmouth, N. J., Army Electron. Labs., Jun. 1966 38 p refs
(DR-32; AD-633693) CFSTI: HC $2.00/MF $0.50

Meteorological data gathered for the launching of Athena Flight Number 041, Vehicle No. D-018 are presented for the Air Force Ballistic Missile Re-Entry Systems Office and for ballistic studies. The data are presented in tabular form. Author (TAB)

N66-33284# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
NIKE-APACHE STV (SR-027) (21 APRIL 1966) AND NIKE-APACHE STV (SR-028) (21 APRIL 1966) Meteorological Data Report
Len E. Carter and Stan F. Kubinski Fort Monmouth, N. J., Army Electron. Labs., May 1966 39 p
(DR-13; AD-633779) CFSTI: HC $2.00/MF $0.50

Meteorological data gathered for the launching of Nike-Apache STV (SR-027) and Nike-Apache STV (SR-028) are presented for the Ballistic Systems Division, U.S. Air Force, and for future ballistic studies. The meteorological data and resulting ballistic data appear in tabular form. Author (TAB)

N66-33300# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
METEOROLOGICAL DATA REPORT, NIKE APACHE STV (SR-029) (2 MAY 1966) AND NIKE APACHE STV (SR-030) (2 MAY 1966)
Gordon L. Dunaway May 1966 42 p
(DR-18; AD-633799) CFSTI: HC $2.00/MF $0.50

Meteorological data gathered for the launching of Nike-Apache STV (SR-029) and Nike-Apache STV (SR-030) are presented for the ballistic systems division, U.S. Air Force, and for future ballistic studies. The meteorological data and resulting ballistic data appear in tabular form. Author (TAB)

N66-33301# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
METEOROLOGICAL DATA REPORT, NIKE CAJUN NICAP/1 ROUND NO. 026 (22 APRIL 1966)
Harold M. Richart May 1966 30 p
(DR-16; AD-633798) CFSTI: HC $2.00/MF $0.50

Meteorological data gathered for the launching of Nike-Cajun NICAP/1, round number 026, are presented for the U.S. Army Electronics Command, Fort Monmouth, New Jersey, and for future ballistic studies. The meteorological data and resulting ballistic data appear in tabular form. Author (TAB)

N66-33391*# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
METEOROLOGICAL DATA REPORT, AEROBEE NASA 4.106 NP (9 MAY 1966)
Marjorie Mc Lardie Hoidale May 1966 33 p refs
(NASA-CR-76571; DR-30) CFSTI: HC $2.00/MF $0.50 CSCL 04B

Meteorological data gathered for the launching of Aerobee NASA 4.106 NP are presented for ballistic studies. The data appear, along with calculated ballistic data, in tabular form. Author

N66-33760*# Weather Bureau, Washington, D. C.
METEOROLOGICAL CONSIDERATIONS IN THE HANDLING OF A MIXTURE OF LIQUID FLUORINE AND LIQUID OXYGEN
Richard K. Siler 15 Oct. 1964 49 p refs Prepared for NASA
(NASA-CR-62579; AD-608118) CFSTI: HC $2.00/MF $0.50 CSCL 04B

A general climatology for those weather elements pertinent to the use of a mixture of liquid fluorine and liquid oxygen for the Cape Kennedy–Merritt Island area is presented, and questions regarding flourine behavior in the atmosphere are outlined. The physical and chemical properties of flourine and its applicable compounds are discussed. Some of the problems that could arise from flourine introduction into the atmosphere are delineated, and recommendations toward possible solution of these problems are offered. The general nature of the diffusion of a gas in the atmosphere and a climatology pertinent to this problem is described briefly. In the absence of weather observations from Merritt Island, some speculations on possible differences in the weather on Cape Kennedy and on Merritt Island are given. A.G.O.

N66-33803 Weather Bureau, Portland Oreg.
SHORT RANGE MINIMUM TEMPERATURE FORECASTING WITH THE ECONOMICAL RADIOMETER
Earl M. Bates and Keith E. Phillips (Portland State Coll.) Washington, Environ. Sci. Serv. Admin., Jan. 1966 11 p refs
(TN-32-WR-5; PB-169812) CFSTI: HC $1.60/MF $0.50

A radiating device to indicate the amount of cooling to be expected of surface objects on a particular night and calibrated to indicate the temperature of the cool surface in °F, was exposed to the sky on clear evenings at Walla Walla, Wash. A record of the resulting temperatures was kept and a record was kept of eight variables which were believed to influence nighttime radiation. A step-wise linear regression was performed with the eight variables to determine how they influenced the variance of the radiometer's reading from the true minimum. Results of the regression are shown in tabular form, with all eight variables explaining 31 percent of the variance of the temperature change from night to morning. Only two of the variables, air temperature and sunset sky cover, proved to be significantly influential; however, the study indicates that the radiometer may be useful as an aid in minimum temperature forecasting. Further study with this instrument is desirable as no test was conducted on independent data. Author

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N66-33805# Weather Bureau, Washington, D. C. National Meteorological Center.
SATURATION THICKNESS TABLES FOR THE DRY ADIABATIC, PSEUDO-ADIABATIC, AND STANDARD ATMOSPHERES
Jerrold A. La Rue and Russell J. Younkin Washington, Environ. Sci. Serv. Admin., Jan. 1966 27 p refs *Its* Tech. Memo No. 35
(TN-30-NMC-35; PB-169382) CFSTI: $1.00

The requirements for a complete moisture parameter include not only a measure of the degree of saturation but also a measure of the quantity of water vapor. "Saturation Thickness" meets these two requirements when the thickness of the layer is also considered. The saturation thickness is defined as the hypothetical thickness required to produce saturation, given the moisture quantity and lapse rate of the layer. Tables of saturation thickness are given for the moist and dry adiabatic, and U.S. Standard Atmosphere lapse rates over a temperature range at 1000 mb. of −40°C to +40°C. The 1000–500-mb. layer has been divided into the three layer intervals corresponding to the standard radiosonde reporting

levels. The tables should obviate the efforts of other investigators to derive this information. The significance of errors arising from assumptions and computational approximations is investigated in the Appendix. Author

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N66-33827# Colorado State Univ., Fort Collins. Fluid Dynamics and Diffusion Lab.

SIMULATION OF ATMOSPHERIC MOTION BY WIND- TUNNEL FLOWS

J. E. Cermak, V. A. Sandborn, E. J. Plate, G. H. Binder, H. Chuang et al May 1966 113 p refs

(Grant DA-AMC-28-043-G20)

(AD-633584) CFSTI: HC $4.00/MF $0.75

The objective of this study was to survey and compile information and experience obtained by the authors with respect to simulation of atmospheric motions by wind-tunnel flows. These notes are restricted to atmospheric phenomena in the lower 1000 m of the atmosphere as determined by the interests of the staff and the capabilities of the wind tunnels associated with the fluid dynamics and diffusion laboratory at Colorado State University. Author (TAB)

N66-33835# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.

HONEST JOHN, MISSILE NO. 1764, ROUND NO. 518 RML (7 APRIL 1966) Meteorological Report

May 1966 20 p

(DR-22; AD-633889) CFSTI: HC $1.00/MF $0.50

Meteorological data gathered for the launching of Honest John, missile number 1764, round number 518 RML, are presented in tabular form. Author (TAB)

N66-33965# Battelle-Northwest, Richland, Wash.

SNOW AND RAIN WASHOUT COEFFICIENTS FOR INORGANIC IODINE VAPOR

R. J. Engelmann and R. W. Perkins 16 Apr. 1965 5 p refs

(Contract AT(45-1)-1830)

(BNWL-SA-155) CFSTI: HC $1.00/MF $0.50

Washout coefficients for gaseous iodine in snowfall and an estimate of the coefficient for rainfall were experimentally determined for the first time. The coefficient for rain is in agreement with theory. The coefficient for snow appears to depend upon crystal type and size as well as upon snowfall rate. Author (NSA)

N66-34006# Florida State Univ., Tallahassee. Dept. of Meteorology.

THE DISTRIBUTION AND DEPTH OF CONVECTIVE CLOUDS OVER THE TROPICAL ATLANTIC OCEAN, DETERMINED FROM METEOROLOGICAL SATELLITE AND OTHER DATA Final Report

Edward J. Zipser and N. E. La Seur Dec. 1965 104 p refs

(Grant Cwb-WBG-36)

(PB-169655) CFSTI: $4.00

A close relationship is found between the depth of the convective layer and the brightness of the individual TIROS cloud units, which is partly due to the interaction between mesoscale cloud patterning and the size of a typical TIROS scan spot. The size of the cloud units is also related to convective layer depth, but not as closely. Factors which must be considered in making brightness estimates are discussed. Differences in gray scale depiction between satellite systems are noted, suggesting that extension of these findings to other systems, although possible, be made with caution. Some determinations of percent aerial coverage by convective clouds are made, which suggest that estimates based on surface ship observations may be systematically high. The potentialities of TIROS medium resolution infrared radiometer data in determining the depth of the convective layer are shown to be rather limited unless supplemented by a data source of higher resolution. Author

N66-34026# Weather Bureau, Washington, D. C.

PRESENT AND FUTURE OPERATIONAL NUMERICAL PREDICTION MODELS

Charles F. Roberts Oct. 1965 23 p refs *Its* Notes to Forecasters No. 3

(TN-16-FCST-3; PB-169126) CFSTI: $1.00

A basic physical and structural description is given of present and future operational numerical weather prediction models. These include the Reed surface 1000 mb. prediction model, the Shuman primitive equation model, and the SLYH quantitative precipitation prediction model. The mathematical models consist of the set of physical equations which describe both the interrelation and the changes in the fields of the three fundamental elements: heat, mass, and momentum. The equations of motion are used to relate the distribution of mass to the field of motion; the equation of state is used to relate changes in the heat and mass fields; and the first law of thermodynamics is used to relate mechanical and thermal energy. These relationships are capable of describing all possible modes of motion which the atmosphere can exhibit. C.T.C.

N66-34041# Weather Bureau, Washington, D. C.

A COMPARISON OF HURRICANE CENTER FIXES MADE BY LAND BASED RADAR AND RECONNAISSANCE AIRCRAFT

Charles R. Holliday Jan. 1966 28 p refs *Its* Radar Note No. 1

(TN-31-RADAR-1; PB-169811) CFSTI: $1.00

Reconnaissance aircraft center fixes for seven hurricanes are compared with a best-fit radar track constructed from center fixes obtained by coastal radars. Results of the comparison indicate that differences of the magnitude of 15 n.mi. are not uncommon and, at times, may well exceed this value. Suggestions are made of the causes of these deviations between the radar best-fit track and aircraft center fixes (both radar and penetration) for each storm. Author

N66-34065# Wisconsin Univ., Madison. Dept. of Meteorology.

AIRMASSES, STREAMLINES, AND THE BOREAL FOREST. APPENDIX: NON-LINEAR PARAMETER ESTIMATION FOR THE PARTIAL COLLECTIVE MODEL OF AIRMASS ANALYSIS

Reid A. Bryson and Donald R. Johnson Feb. 1966 81 p refs

(Contract Nonr-1202(07); Grant NSF GP-444)

(TR-24; AD-634095) CFSTI: HC $3.00/MF $0.75

The July airmass frequency distribution over Canada is analyzed by daily computation of trajectories from grid intersections back to source regions. A zone of rapid transition from Arctic air dominance to Pacific air dominance is found to lie along the northern border of the boreal forest, suggesting that the summer airmass distribution might be an important causal factor for the distribution of forest versus tundra. An independent analysis of July airmass frequency distribution by resolution of the daily maximum temperature frequency distribution into partial collectives (component normal distributions) yields results very similar to the trajectory analysis but with more detail. This analysis suggests that airmass dominance might be of importance to other biotic regions as well as the boreal forest and tundra. A final analysis using monthly resultant wind streamlines near the surface indicates that mean airstreams and confluences between airstreams define climatic regions with a distinctive annual march of

airstream (and in the mean, airmass) dominance. These regions show a clear congruence with several major biotic regions. These analyses strongly suggest that the boreal forest occupies the region between the mean (or modal) southern boundary of Arctic air in winter and the mean southern boundary of Artic air in summer. Author (TAB)

N66-34077# Chicago Univ., Ill. Dept. of the Geophysical Sciences.

APPLICATION OF PRECISE FUJITA METHOD ON NIMBUS I PHOTO GRIDDING

Ruben Nasta Jan. 1966 18 p refs In SPANISH; ENGLISH summary

(Grant Cwb-WBG-34)

(SMRP-RP-47; PB-169654) CFSTI: $1.60

Since a set of three pictures was taken simultaneously by three AVCS cameras with their optical axes rigidly fixed to the spacecraft, the distortion-free grids of three images were projected to the image plane of the central camera. The distortion-free fiducial grid, thus constructed to fit Fujita's tilt grids, revealed that the tilts of both the left and right cameras are 36.0°±0.1°. Test analyses of two sets of three pictures over South America and nearby oceans revealed that the distortion-free grid can be used on a zero-tilt grid when the Nimbus is perfectly earth oriented. If not, the final gridding errors or the vector errors of landmarks permit us to calculate pitch, roll, and yaw of the spacecraft. It is concluded that this method of precise rectification of Nimbus AVCS photographs will help meteorologists and researchers to analyze synoptic situations which cannot be studied completely and easily by using conventional information only, and will especially contribute to the better understanding of weather phenomena over large bodies of water. Author

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N66-32957*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A SYSTEM FOR INERTIAL EXPERIMENT POINTING AND ATTITUDE CONTROL

Peter R. Kurzhals and Carolyn Grantham Washington, NASA, Aug. 1966 67 p refs

(NASA-TR-R-247) CFSTI: HC $2.50/MF $0.75 CSCL 17G

A system for inertial experiment pointing and attitude control (designated SIXPAC) of future manned spacecraft has been investigated. The SIXPAC concept consists of three double-gimbaled control moment gyros alined with the axes of the spacecraft, and derives its control torques from precession of the gyro wheels. This system is readily mechanized, has inherent redundancy, and should provide a wider range of attitude control for manned spacecraft than the gyro systems previously considered. The SIXPAC can provide both the large range of control torques and the fine attitude holds associated with spacecraft experiments such as earth-surface tracking and mapping, photographic missions, and astronomical observations. Periodic aerodynamic and gravity-gradient torques can also be counteracted by the proposed system. Redundancies inherent to the three-gyro arrangement further allow reduced spacecraft control in case of failure or shutdown of one of the three gyros. Author

N66-33103# Federal Aviation Agency, Atlantic City, N. J. Systems Research and Development Service.

EVALUATION OF THE ASR VIDEO PHOTOGRAPHIC RECORDING TECHNIQUE Final Report

Gerald E. Titherington Aug. 1965 32 p

(RD-65-99; PB-169151)

The requirement for a practical means of recording air traffice history as derived from radar displays resulted in an evaluation of the photographic technique described in this report. This purpose of the evaluation was to determine whether the photographic technique was suitable for recording radar video data and whether the photographic record was adequate for subsequent re-creation of an air traffic situation. Data were obtained by photographing radar presentations at the John F. Kennedy Tower facility during periods of high air traffic activity. Reconstruction of the traffic situations using these photographic records was accomplished by air traffic controllers. The photographic recording technique incorporating particular equipments and procedures was suitable for recording radar video data and was adequate for re-creating air traffic situations. It was recommended that: (1) an investigation of support requirements be conducted to determine practicability of operational implementation; (2) consideration be given to development of a prototype system; and (3) specifications for prototype equipment include certain listed minimal criteria. Author

N66-33448*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

VISUAL SIMULATION OF LUNAR ORBIT ESTABLISHMENT USING A SIMPLIFIED GUIDANCE TECHNIQUE

G. Kimball Miller, Jr. and Gene W. Sparrow Washington, NASA, Aug. 1966 37 p refs

(NASA-TN-D-3524) CFSTI: HC $2.00/MF $0.50 CSCL 17G

A fixed-based simulator study was conducted to determine the ability of pilots to establish 80-nautical-mile (148.16-km) circular orbits about the moon by using a simplified guidance technique during retrothrust from a typical lunar approach trajectory. The pilot had control of thrust along the longitudinal axis and of vehicle attitude through an acceleration command system. No automatic damping or control were assumed. The general guidance procedure consisted of maintaining a constant angle between the vehicle thrust axis and the line of sight to the receding lunar horizon while applying thrust for a predetermined period of time. Several approach trajectories were considered for which the thrust angles and thrusting times were determined just prior to thrust initiation. The results of the investigation showed that orbits near the desired parking orbit were established from the various approach trajectories considered when the instrumentation presented to the pilot consisted of only a three-axis gyro horizon nulled to the desired orientation in the plane of the approach trajectory. When the pilot was required to track the lunar features in order to aline the spacecraft with respect to the plane of the orbit and to apply thrust without the benefit of any instrumentation, his performance was degraded. Author

N66-33492*# Bendix Corp., Teterboro, N. J. Eclipse-Pioneer Div.

STUDY TO DEVELOP THE EQUATIONS DESCRIBING THE CHARACTERISTICS OF RATE AND ATTITUDE SENSORS ASSOCIATED WITH SPACECRAFT CONTROL SYSTEMS

Jack Clair Apr. 1966 196 p

(Contract NAS1-4974)

(NASA-CR-66157) CFSTI: HC $3.25/MF $1.25 CSCL 17G

The intent of this report is to provide computation requirements for the evaluation of four integrated sensor systems in carrying out their respective attitude modes. For each attitude mode, the requirements are itemized in compatibility

with accompanying simulation block diagrams and include error models of the sensors utilized. Evaluations are available via computations of the true angular deviations of the spacecraft from its required attitude. Peak values or RMS values of these deviations are the types of figures of merit by which the integrated systems can be evaluated. Data additional to the error models of the sensors (scale factor, dynamic range, format of output, cost, delivery time, power, weight, volume and reliability) are also included in the report. Author

N66-33626# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE ELECTRONICS AND GUIDANCE OF INTERPLANETARY FLIGHT

Tan Wei yi 17 Mar. 1966 10 p Transl. into ENGLISH from Wu Hsien Tien (China), no. 11, 1963 p 1–3

(FTD-TT-65-1430/1+2+3+4; AD-633684) CFSTI: HC $1.00/MF $0.50

The topics covered include rocket guidance systems, preset self-guided missile systems, command control guidance systems, beam-rider guidance systems, spacecraft free flight, guidance systems in interplanetary flight, launch guidance, midway guidance, and end guidance and landing control. TAB

N66-33801# Litton Systems, Inc., Woodland Hills, Calif. Guidance and Control Systems Div.

EVALUATION OF INERTIAL NAVIGATION SYSTEM IN CIVIL AIR TRANSPORT OPERATIONS. VOLUME I: LN-12 INERTIAL NAVIGATION SYSTEM. BOOK I: DISCUSSION AND ANALYSIS Final Report

Robert J. Holm 15 Jun. 1966 193 p refs

(Contract FA-65-WA-1112)

(AQ22016E66, Book I; RD-66-30-I)

An LN-12 inertial navigation system, with an inertial navigation steering computer, was flown in a DC-8 aircraft for 55 scheduled transatlantic crossings and 32 other short flights, domestic and foreign. Performance data were collected on inertial accuracy, steering behavior, track holding, maintenance, reliability, in-flight operation, position checks and azimuth drift. Eighty percent of the flights exhibited terminal errors of 10 miles or less in either latitude or longitude coordinates. Two transatlantic flights are examined in detail for doppler comparison in cross track miles to go, ground speed, and drift angle. These flights are also analyzed for comparison with aircraft compass heading, measured track, drift angle, miles to go, track heading, and waypoint misses. Author

N66-33802# Litton Systems, Inc., Woodland Hills, Calif. Guidance and Control Systems Div.

EVALUATION OF INERTIAL NAVIGATION SYSTEM IN CIVIL AIR TRANSPORT OPERATIONS. VOLUME I: LN-12 INERTIAL NAVIGATION SYSTEM. BOOK II: DATA SHEETS

Robert J. Holm 15 Jun. 1966 336 p

(Contract FA-65-WA-112)

(AQ22016E66, Book II; RD-66-30-I)

The position error, ground speed, and aircraft tracking data for the inertial navigation evaluation program are recorded. The aircraft position data sheets indicate the along-track and cross-track distances as well as navigational instrumental data on the heading, track angle, drift angle, and ground speed. A comparison is made of ground speed and drift angle data obtained from both inertial and doppler systems. Position-fixed longitude and latitude coordinates are given, as are true airspeeds at various intervals, for reference. Bench tests and inertial flight steering data are included. R.LI.

N66-34032# Instrument Pilot Instructor School, Randolph AFB, Tex.

FLIGHT DIRECTOR/FLIGHT PATH ANGLE APPLICATION TO NON-ILS APPROACH ENVIRONMENT

Mar. 1966 12 p

(AD-632029) CFSTI: HC $1.00/MF $0.50

Four pilots flew 72 hooded approaches to determine the application of flight director techniques, flight path angle and absolute altitude information to a non-ILS approach environment. It was determined that: (1) Flight director techniques can be used in a non-ILS approach environment to increase precision and decrease pilot workload. (2) Path angle information is more meaningful to the pilot than vertical velocity for glide slope following. (3) Pitch augmented rate, the vertical component of flight path angle, is a significant improvement over barometric vertical velocity. (4) Due to variations in terrain contour, the utility of absolute altitude with current landing weather minima is limited. However, it is essential to an IFR touchdown capability. Properly presented it provides the pilot with accurate and easily interpreted rate of closure information. Author (TAB)

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N66-32859# Brookhaven National Lab., Upton, N. Y.

THE SENSITIVITY OF REACTOR CHARACTERISTICS TO CROSS SECTION UNCERTAINTIES BELOW 100 eV

R. L. Hellens Mar. 1966 44 p refs Presented at the Am. Phys. Soc., Conf. on Neutron Cross Sect. Technol., Washington, D. C.

(Contract AT(30-2)-GEN-16)

(BNL-10058; CONF-660303-1) CFSTI: HC $2.00/MF $0.50

The development of accurate computational methods for thermal reactor lattices has reached the point at which neutron cross section uncertainties are a major limitation to the confidence with which theory can be applied to practical situations. This sensitivity to nuclear data is readily seen in the analysis of extremely simple lattice experiments, although it is still present, of course, in calculations for power reactors of greater geometrical complexity where errors in describing spatial effects may effectively hide basic discrepancies. The basic lattice data and computational methods are briefly reviewed and the connection between uncertainties in cross sections and in predicted reactor characteristics is traced for some typical reactor lattices. The effect during reactor life of changes in the cross sections assigned to both fertile and fissile isotopes in the uranium and plutonium chains is described in light and heavy water moderated reactors. Author (NSA)

N66-32877# Oak Ridge National Lab., Tenn.

NEUTRON CROSS SECTIONS IN THE ENERGY RANGE 100 eV$<E_n<$100 KeV: RECENT PROGRESS, CURRENT STATUS, FUTURE OUTLOOK

J. H. Gibbons [1966] 39 p refs Presented at the Am. Phys. Soc. Conf. on Neutron Cross Section Technol., Washington, 22–24 Mar. 1966

(Contract W-7405-ENG-26)

(ORNL-P-2106; CONF-660303-28) CFSTI: HC $2.00/MF $0.50

The technology of measuring cross sections in the energy range 100 eV<E_n<100 KeV has advanced significantly over the past several years. The most notable developments have occurred in detectors for capture cross section measurements, available neutron energy resolution in general, and absolute values for flux normalization. Reactor design needs for total and capture cross sections can apparently be met with existing or feasible equipment. The primary exceptions to this statement are highly radioactive materials and some of the higher accuracy requests. Reaction theory and measured reaction systematics are insufficiently understood to enable more than an educated guess at unmeasured capture cross sections. Author (NSA)

N66-33021*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

CRITICAL MASS STUDIES WITH THE NASA ZERO POWER REACTOR II. III: HETEROGENEOUS ARRAYS OF CYLINDRICAL VOIDS

Thomas A. Fox, Robert A. Mueller, and C. Hubbard Ford Washington, NASA, Aug. 1966 25 p refs

(NASA-TN-D-3555) CFSTI: HC $1.00/MF $0.50 CSCL 18L

The NASA Zero Power Reactor II (ZPR-II) has been used to determine experimentally several critical cylindrical configurations of aqueous fuel solutions that contain heterogeneous arrays of voids. These voids are cylindrical, are symmetrically arranged parallel to the axis of the reactor, and extend the height of the core. The study covered a wide range of highly enriched (93.2 percent U^{235}) aqueous uranyl flouride fuel concentrations. The ZPR-II core has a diameter of 76.2 centimeters and a height that permits the solution level to be increased to about 90 centimeters. The reactor system may be operated either bare or radially reflected by about 15 centimeters of water. The specific reactor void configuratons consisted of symmetrical arrays of 1, 7, 19, 31, and 37 tubes approximately 7.6 centimeters in diameter arranged in hexagonal geometry with pitches of 9.652 or 10.922 centimeters. In addition to the critical mass and geometry, data are presented on the thermal neutron flux distributions in the central radial plane, and on the variation of void reactivity importance with radial position. These data explain qualitatively some of the reactivity effects associated with the different void spacings. Autnor

N66-33028# United Kingdom Atomic Energy Authority, Risley (England). Reactor Group.

RATCHET AND FATIGUE MECHANISMS IN SEALED FUEL PINS FOR NUCLEAR REACTORS

J. Bree 1966 52 p refs

(TRG-1214(D))

A sealed reactor fuel can when subjected to sufficiently high thermal stresses in the presence of an internal pressure will yield plastically. Using a simplified model, it is shown that the plastic strains may cause ratchetting or plastic cycling as the temperature gradient across the can wall is cycled due to start-up and shutdown of the reactor. Assuming creep to be negligible, approximate criteria are derived for the onset of ratchetting and plastic cycling, simple expressions are obtained for the plastic strains incurred by each cycle and failure of the can is discussed both for work-hardening and non-work-hardening material. Consideration is then given to the effect of stress relaxation due to creep when the can mean temperature is sufficiently high to cause complete relaxation of the thermal stress while the reactor is at power, creep being ignored while the reactor is shutdown. It is found that the criterion for ratchetting is simply the criterion for plastic yielding during the first temperature cycle. Finally, it is shown that the results also hold for the similar problem of a thin spherical shell subjected to an internal pressure and a temperature gradient across the shell wall which is cycled. Author

N66-33116# United Kingdom Atomic Energy Authority, Risley (England). The Reactor Group.

PYROLYTIC-CARBON-COATED URANIUM CARBIDE PARTICLES: THE EFFECT OF DEPOSITION CONDITIONS ON COATING EFFICIENCY, STRUCTURE AND DENSITY

DENSITY

L. H. Ford, B. E. Ingleby, and N. S. Hibbert 29 Mar. 1966 20 p refs Presented at the DRAGON Contractors' Res. and Develop. Symp. AERE, Mar. 1966

(TRG-1180(S)) HMSO: 5s

The efficiency of deposition of pyrolytic carbon coatings on uranium monocarbide particles has been shown to vary directly with the surface area of the bed and temperature of deposition, and inversely with increase in methane partial pressure and degree of fluidization. Variations of coating structure have been classified into five groups, four according to the degree of isotropy and the size of the grain structure observed, and the fifth by the absence of any visible structure. For the equipment used, the structure of the coatings was found to vary with the surface area of the charge, the temperature of coating, gas composition, and the degree of fluidization. Measurements of coating density show the well known minimum density region in the temperature range 1400°–1600°C but independently of coating structure.

Author

N66-33122# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.

BASIC STUDIES OF SOME FISSION PRODUCT DICARBIDES AND THE RELEASE PHENOMENON

R. L. Faircloth and R. H. Flowers Mar. 1966 14 p refs

(AERE-R-5191)

A study was made of the vaporization behavior of some pure metal carbides, in order to determine the diffusion mechanism of metallic fission products which escape relatively quickly from carbon-canned fuels. The carbides were prepared in a pure state by direct combination of the elements in evacuated molybdenum bombs at temperatures between 1500°C and 2000°C, and subsequently handled in a pure helium atmosphere. Vapor pressure measurements in the 900°C to 1400°C range were made by means of a Knudsen effusion technique, and analysis of the vapor phase was accomplished by use of a mass spectrometer. Among the conclusions are that the dicarbides of Ca, Sr, and Ba are well defined phases which show no detectable departure from the composition $MC_{2.00}$. Addition of excess metal causes the vapor pressure to rise sharply, while addition of excess carbon has no effect on the pressure. The rare earth dicarbides produce only the monatomic metal in the vapor phase at temperatures of 900°C to 1400°C. C.T.C.

N66-33125# Aktiebolaget Atomenergi, Stockholm (Sweden).

REACTION RATE DISTRIBUTIONS AND RATIOS IN FRO ASSEMBLIES 1, 2, AND 3

T. L. Andersson 1966 60 p refs

(AE-229) CFSTI: HC $3.00/MF $0.75

The spatial distribution of different reaction rates and reaction ratios in assemblies 1, 2, and 3 of the fast reactor FRO was measured by fission chamber scans and foil activation techniques. Assemblies 1 and 2 had cores of undiluted fuel (uranium metal enriched to 20% U^{235}) while the core of assembly 3 was diluted with about 30 vol. % graphite. All the systems had a thick copper reflector. The experimental results were compared with calculated values obtained from DSN and TDC multigroup spectra and group cross-section sets for the reactions. Good agreement between experiment and calculations is generally obtained in the core region but in the reflector the neutron spectrum is calculated too hard. Author

N66-33128# European Atomic Energy Community, Brussels (Belgium).
RDMM—A CODE FOR FAST NEUTRON SPECTRA DETERMINATION BY ACTIVATION ANALYSIS
G. Di Cola and A. Rota Jun. 1966 36 p refs
(EUR-2985.e) CFSTI: HC $2.00/MF $0.50

A Fortran code for a relative deviation minimization method is described, which allows the automatic interpretation of the activation data for the in-pile fast neutron spectra determination. Limitations of the code are explained, and results of the activation analysis are presented. S.P.

N66-33429# European Atomic Energy Community, Brussels (Belgium).
THE USE OF PULSED REACTORS IN THE FIELD OF NEUTRON AND SOLID STATE PHYSICS
W. Kley 1965 58 p refs Presented at the Symp. "Panel on Kinet. and Appl. of Pulsed Res. Reactors", Vienna, 17–21 May 1965
(EUR-2538.e) CFSTI: HC $3.00/MF $0.75

The neutron source requirements are examined for a particular selection of experiments in the field of neutron and solid state physics. For a number of facilities, the principal design features are given. A quantitative comparison of experiments at a pulsed reactor of the SORA type with those at a Very High Flux Reactor is given. The figure of merit in favour of the SORA type reactor is within the limits of $1 \leq M \leq 40$ for experiments with thermal and subthermal neutrons. In general, the pulsed reactor is better by the flux ratio $M = \phi SORA/\phi V.H.F.R.$ for experiments using the time of flight technique. Author

N66-33547# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
USERS MANUAL FOR SRL–HERESY I, HETEROGENEOUS REACTOR SYSTEMS CODE FOR THE IBM 704
Donald R. Finch Mar. 1966 122 p refs
(Contract AT(07-2)-1)
(DP-1027) CFSTI: HC $4.00/MF $0.75

A detailed description of the SRL–HERESY I code (a production version of the HERESY I code developed by C. N. Klahr) is presented in a manner primarily intended for the user of the code. The heterogeneous reactor theory on which the code is based is developed briefly and followed by detailed coding information. Methods are given for solving finite or semi-infinite lattices containing up to 6500 lattice assemblies of up to 50 different types with unique geometrical or flux symmetry properties. Special techniques used with reflected reactor lattices are also described. Several examples of computations are presented as aids in testing and using the code. Detailed descriptions of programming and operating procedures are presented as appendices. Author (NSA)

N66-33549# Los Alamos Scientific Lab., N. Mex.
GAMMA DOSE RATE MEASUREMENTS ON THE PHOEBUS 1A-321 REACTOR
A. J. Ahlquist and F. W. Sanders 10 May 1966 19 p refs
(Contract W-7405-ENG-36)
(LA-3448-MS) CFSTI: HC $2.00/MF $0.50

Gamma-ray dose rate measurements were made on Experimental Plans 2, 3, and 4 of the Phoebus 1A-321 reactor testing series. Extrapolation of data from 180 feet gave a dose rate of 36.0 R/min-MW at the 60 foot station during the full power run (Experimental Plan 4). The average gamma-ray dose rate of the eight Kiwi reactors at the 60 foot station was 35.1 R/min-MW. Instrument difficulties necessitated using xylene (gamma-neutron sensitive) detectors as gamma detectors. Integral doses show that they give a reasonable approximation of gamma dose rates. Author (NSA)

N66-33559# Battelle Memorial Inst., Columbus, Ohio.
DEVELOPMENT OF CERAMIC-COATED-PARTICLE NUCLEAR FUELS Summary Report
Charles W. Townley, ed. 25 Apr. 1966 95 p refs
(Contract W-7405-ENG-92)
(BMI-1768) CFSTI: HC $6.00/MF $0.75

All aspects of the development of ceramic-coated-particle nuclear fuels were covered, with emphasis on pyrolytic carbon, alumina, and beryllia as the basic coating materials. Consideration was given to the reactor-physics requirements for the coated particles, methods of fabricating the materials, in-pile and out-of-pile evaluations, compatibility problems, radiation damage, and fission-product retention. PyC coatings were deposited on UC_2 and UO_2 particles in a fluidized bed by pyrolysis of hydrocarbon gases, primarily methane and acetylene. Satisfactory coatings were prepared at 950° to 2000°C over a wide range of deposition rates. Coating failure was eliminated by increasing the coating thickness to over 100 μ (on 200-μ-diameter substrates) and introducing porosity by use of either porous UO_2 substrates or multiplex coatings having an inner layer of 20 to 30 μ of porous carbon. Solid-fission-product retention, the major problem remaining with PyC, was improved by the use of oxide layers, SiC layers, or SiO_2 dopants to the coatings. Dense alumina coatings 60 μ thick, deposited on 200-μ, porous (80% dense) UO_2 particles performed without failure to a ^{235}U burnup of at least 10 at. % at temperatures to 1100°C. Coating thickness and fuel density were selected to overcome low-temperature cracking found during irradiation experiments. Alumina was one of the best materials studied in retaining fission products, and the fractional release would not be expected to exceed 10^{-6} in a reactor. The BeO coatings had large grains and were unsuccessful in irradiation tests. Various coating conditions and grain-growth inhibitors or interrupters were used with only partial success in an effort to produce fine-grained coatings. The most practical coating material evaluated for use in a gas-cooled power reactor was pyrolytic carbon since it was superior to alumina in neutron economy and less expensive than either beryllia or alumina. With an inert-gas coolant, PyC-coated particles in a graphite matrix were not as limited in maximum operating temperature as alumina- or beryllia-coated particles. Author (NSA)

N66-33560# Battelle Memorial Inst., Columbus, Ohio.
ETR IRRADIATIONS OF PYROLYTIC-CARBON-COATED FUEL PARTICLES
Neil E. Miller, Robert L. Martin, Harvey S. Rosenberg, Robert B. Price, and Charles W. Townley 11 May 1966 35 p refs
(Contract W-7405-ENG-92)
(BMI-1772) CFSTI: HC $2.00/MF $0.50

Triplicate specimens of each of 25 lots of PyC-coated fuel particles were irradiated in the ETR at temperature of nominally 550°, 1100°, and 1300°C to burnups on the order of 2×10^{21} fissions per cm^3. The samples included coatings of monolithic laminar pyrolytic carbon, duplex pyrolytic carbon (laminar over porous), and composite pyrolytic carbon (PyC over BeO or SiC) applied to uranium- or (thorium–uranium)-base fuel particles. Postirradiation fission-gas-release measurements and metallographic examinations were used to study the effects of coating composition and thickness, fuel composition and density, and irradiation temperature. No definite effects of fuel composition and irradiation temperature were observed. Duplex and composite coatings showed the best performance with some additional improvement noted when used on fuel cores of lower density. Of the monolithic coatings, only the thick coating showed no failure. Results of four irradiations at the BRR showed no failure of monolithic PyC coatings on large, porous UO_2 particles irradiated to high burnup. Author (NSA)

N66-33561# Battelle-Northwest, Richland, Wash.
CERAMICS RESEARCH AND DEVELOPMENT Quarterly Report, Jul.–Sep. 1965
C. E. Mc Neilly et al 3 May 1966 132 p refs
(Contract AT(45-1)-1830)
(BNWL-198) CFSTI: HC $4.00/MF $1.00

Continuing investigations in ceramics research and applications are reported. UO_2, PuO_2, and UO_2–PuO_2 fuel development was emphasized, and their chemical and physical properties were studied. Materials and joining development, and PRTR fuel element performance and fabrication are discussed. N.E.N.

N66-33723*# National Aeronautics and Space Administration, Washington, D. C.
USE OF THE METHOD OF "REMOVAL CROSS SECTION" FOR THE COMPUTATION OF SHIELDING NOT CONTAINING HYDROGEN [PRIMENENIYE METODIKI "SECHENIY VYVEDENIYA" DLYA RASCHETA ZASHCHITY, NE SODERZHASHCHEY VODOROD]
D. L. Broder, A. A. Kutuzov, V. V. Levin, and V. V. Frolov May 1966 15 p refs Transl. into ENGLISH from the Book "Fiziki Zashchity Reaktorov" Moscow, Gosatomizdat, 1963 p 52–60
(NASA-TT-F-10155) CFSTI: HC $1.00/MF $0.50 CSCL 18F

The method of removal cross section, equivalent to the neutron absorption cross section in the group with an energy interval of $\Delta E = E - E_{thr}$ (where E_{thr} is the threshold energy), is used for computing hydrogen-free shieldings in which media other than water (e.g., boron carbide or aluminum) are used as moderator. Diagrams and Tables of the spatial distribution of neutrons with energies of 4 and 14.9 MeV in Th^{232} and U^{235} fission chambers show that the removal cross section reaches saturation at relatively short distances r_0 from source to detector and that at distances greater than r_0 the cross section, in a homogeneous mixture, is close to that measured in heterogeneous types. The method is applicable also to heavy moderators such as iron, although considerable underestimates occur because of the dependence of the removal cross section on the atomic weight of the moderator. Author

N66-33762# United Kingdom Atomic Energy Authority, Risley (England). The Reactor Group.
THE EVALUATION OF NUCLEAR FUEL ELEMENT COMPONENTS. A REVIEW OF SOME RECENT WORK IN THE MATERIALS SCIENCE GROUP OF THE U.K.A.E.A. REACTOR FUEL ELEMENT LABORATORY AT SPRINGFIELDS
J. H. Gittus 25 Jun. 1965 45 p
(TRG-975(S))

A wide range of investigations into the properties of nuclear fuel element components is in progress. Zirconium alloys, stainless steels, magnesium alloys, ceramics and dilute alloys of uranium are some of the materials involved. Properties being studied include instantaneous and time-dependent deformation processes, creep, fatigue, relaxation, preferred orientation, transformation-kinetics, friction, thermal conductivity, expansivitiy, resistivity, and irradiation effects. New theories of creep and fatigue are being developed leading to refinements of prediction and extrapolation. Testing procedures are also being improved, particularly the detection of flaws by ultrasonic measurements and color radiography. Author

N66-33868# General Electric Co., San Jose, Calif. Advanced Products Operation.
EVESR NUCLEAR SUPERHEAT FUEL DEVELOPMENT PROJECT Quarterly Report No. 15, Dec. 1965–Feb. 1966
R. R. Roof, comp. Mar. 1966 108 p
(Contract AT(04-3)-189)
(GEAP-5125) CFSTI: HC $4.00/MF $0.75

During this period, operation of the ESADA-Vallecitos Experimental Superheat Reactor (EVESR) was continued in the full-power range of 15 to 17 Mw(t) in support of the Superheat Fuel Development Program. On January 5, 1966, a significant transient increase occurred in the radioactivity release from Mark II fuel bundle KB-11. During subsequent full-power operation, the steady-state release of radioactivity from KB-11 was only about one-quarter of that from KB-29, and it consisted primarily of volatile fission products. Fuel bundle KB-11 will be removed from the reactor during the planned reactor outage in March for examination of the apparent cladding defect. To obtain more experience on superheat fuel performance and radioactivity release when the fuel is operated with a known defect in the cladding, preparations were completed to install in EVESR at Mark III fuel rod having a defect in the cladding. The defect consists of a slot 0.080×2 inches long cut through the 0.020-inch-thick Incoloy-800 cladding. The defected fuel rod will be installed in EVESR during the March shutdown. Mark III fuel bundle KB-41, which was removed from the reactor in July 1965 to permit examination of a failed fuel rod, was reconstituted using two seven-rod clusters of new unirradiated fuel and two clusters of fuel previously irradiated in KB-41. The new fuel was supplied by the NSPE Project. The irradiated fuel has 0.008-inch-thick Incoloy-800 cladding. The availability of the new fuel clusters has made it possible to reassemble the bundle of four clusters and resume the irradiation of the fuel with 0.008-inch-thick cladding. Small, but potentially significant, quantities of lead were measured in the moderator and boiler water. The lead concentrations measured were less than 1 ppM. Lead in larger concentrations is reported to cause accelerated local corrosive attack in high-nickel alloys. Capsule irradiations of superheat fuel cladding material specimens continued in EBR-II and GETR as a basis for studying the effect of fast and thermal neutron irradiation on the mechanical properties of these materials. Capsule SC-10 continued irradiation in GETR and has received a peak exposure of approximately 1.1×10^{21} nvt (En≥1 MeV). Capsules MT-3 and MT-4 were installed in the EBR-II core in December 1965, and are scheduled to receive an exposure of $>10^{22}$ nvt (En≥1 MeV) during a 12-month period. Author (NSA)

N66-33869# Oak Ridge National Lab., Tenn.
FABRICATION PROCEDURES AND PREIRRADIATION DATA FOR (TH, U^{-233}) O_2-BEARING IRRADIATION RODS
J. D. Sease and A. R. Olsen May 1966 32 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1461) CFSTI: HC $2.00/MF $0.50

For irradiation testing in the ETR process water at high thermal ratings, 18 fuel rods containing vibratorily compacted sol-gel (Th–3% $^{233}U)O_2$ were fabricated semiremotely in the Kilorod Facility. These Zircaloy-2-clad rods are the first containing ^{233}U fuel that have been fabricated for the irradiation program on vibratorily compacted sol-gel thoria-base fuels. In the processing of fuel for vibratory compaction, the most significant uncontrolled variable is the effect of the cell atmosphere on sorbed gases in the fuel. To evaluate the effect of sorbed gas on the irradiation behavior of this fuel, one-half of the fuel rods fabricated were loaded with fuel that had been exposed to ambient air in normal handling; the other rods were loaded with fuel that had been refired in Ar–4% H_2 just before loading. Pertinent preirradiation processing data on these rods are included. Author (NSA)

N66-33877# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Obninsk (USSR). Fiziko-Energeticheskii Inst.
CERTAIN PROBLEMS IN THE DESIGN OF A THERMIONIC EMISSION CONVERTER-REACTOR [NEKOTORYE PROBLEMY RAZRABOTKI TERMOZMISSIONNOGO REAFTORA-PREOBRAZOVATELYA]

V. Ya. Pupko, V. A. Malykh, I. M. Gusakov, V. G. Petrovskii, V. M. Dmitriev et al 1965 17 p refs In RUSSIAN
(FEI-27)

Fission heat can be directly converted to electrical energy by heating up an electron emitter cathode in direct contact with fissile materials to a temperature of 1400° to 2000°C. A concentric collector of some refractory material is used with cesium vapor in the gap. A fast neutron reactor has a specific electrical power of 10 to 30 kilowatts/liter at a cathode temperature of 1800° to 2000° C. The heat flux depends strongly on the ^{235}U concentration. Power leveling can be achieved by varying the ^{235}U concentration in the core. The specific power of a slow neutron reactor is considerably less than that of a fast neutron reactor. Zirconium hydride $ZrH_{1.8}$ can be used as a moderator. The size of the reactor core and ^{235}U requirements are plotted as a function of the volume percent of the moderator in the core and of the uranium concentration in the converter. Minimum reactor size is obtained at 0.7 volume fraction of moderator in the core. A discussion of the electrical and thermal losses is presented. Converters made of UC+ZrC without cladding and with an NbC cladding, and of UO_2 with Mo cladding were placed in a reactor for testing. A three-element assembly consisted of series-connected rods each 20 mm long. The cathode material was Mo. The anode was Nb. The interelectrode gas was ~0.5 mm. Typical volt–ampere characteristics are presented. Calculated surface temperatures are compared with the experimental values. Author (NSA)

N66-33879# General Dynamics Corp., San Diego, Calif. General Atomic Div.
A PROGRAM OF BASIC RESEARCH ON MECHANICAL PROPERTIES OF REACTOR MATERIALS Quarterly Progress Report, 1 Nov. 1965–31 Jan. 1966
R. H. Chambers and T. A. Trozera 28 Mar. 1966 22 p refs Submitted for Publication
(Contract AT(04-3)-167)
(GA-6996) CFSTI: HC $1.00/MF $0.50

Resistivity measurements are used to characterize the changes in properties of reactor materials due to neutron irradiation. Calculations are presented for a correction to the resistivity ratio for orbital scattering of conduction electrons at the surface of the crystal. A new nondestructive and highly reproducible method of measuring the preyield plastic properties of relatively brittle metals is described. Author (NSA)

N66-33891# Oak Ridge National Lab., Tenn.
DESIGN OF AN IRRADIATION EXPERIMENT TO TEST COATED-PARTICLE FUELS TO HIGH BURNUP
A. W. Longest and J. A Conlin May 1966 81 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1427) CFSTI: HC $3.00/MF $0.75

A capsule irradiation experiment was designed to evaluate the performance of pyrolytic-carbon coated UO_2 and UC_2 particles to burnup in the range of 50–80 at. % heavy metal. The irradiation is to be conducted in the ORR F-9 Facility. Burnup rate is to be limited to a maximum of 10 at. % heavy metal per month and fuel temperature is to be maintained between 1100° and 1400°C throughout the one-year irradiation, with emphasis on the higher temperature. The fuel specimens are to be continuously swept with an inert gas purge, which is periodically sampled for fission-gas release measurements. The capsule has two batches of fuel particles, each in an annular monolayer supported in a graphite structure. Each batch contains ≈0.1 g of 93% enriched uranium. Author (NSA)

N66-33892# United Nuclear Corp., Elmsford, N. Y.
CARBIDE FUEL DEVELOPMENT Final Report, 15 May 1959–15 Oct. 1965
A. Strasser and J. Cihi 15 Oct. 1965 196 p refs
(Contracts AT(30-1)-2899; AT(30-1)-2303)
(UNC-5134, Vol. 2) CFSTI: HC $5.00/MF $1.25

Irradiation tests of 12 clad $(U_{0.8}Pu_{0.2})C$ specimens in the range of 20,000 to 113,000 Mwd/T at 490 to 570 w/cm (avg) demonstrated the structural and dimensional stability of the fuel. The microstructure of the fuel was essentially unchanged by irradiation. The fuel OD increased 0.5 to 0.6% per at. % burnup. The fission gas release increased from less than 1% at 7×10^{20} fiss/cm^3 and 1% at 13×10^{20} fiss/cm^3 to 30% at 38×10^{20} fiss/cm^3. This was accompanied by a significant increase in fuel porosity at the center. No significant differences were noted between the 91% dense fuel without sintering aid, and the 95% dense fuel made with Ni sintering aid. The six Nb-clad specimens were sound and in excellent condition. The clad OD was unchanged up to 35,000 Mwd/T. At 114,000 Mwd/T, there was an average 2.5% OD increase. Of the six stainless steel-clad specimens, one was in excellent condition, one failed because of an experiment malfunction, and four were ruptured as a result of the drastic decrease in steel ductility to a level below that required to accommodate strains from fuel expansion and thermal stresses. NSA

N66-33900# General Dynamics Corp., San Diego, Calif. General Atomic Div.
DEFORMATION AND FRACTURE OF PYROLYTIC CARBONS DEPOSITED IN FLUIDIZED BEDS
J. C. Bokros and R. J. Price 21 May 1965 42 p refs
(Contract AT(04-3)-167)
(GA-6332) CFSTI: HC $2.00/MF $0.50

Pyrolytic carbon formed by the pyrolysis of hydrocarbon gas in a fluidized bed is used as a coating for nuclear fuel particles. An investigation was undertaken to relate the mechanical properties of such deposits to their structure, which in turn depends on the deposition conditions and subsequent heat treatment. Carbons deposited from methane between 1350 and 1925°C were characterized according to their density, degree of preferred orientation, apparent crystallite size, and micrographic appearance (laminar, isotropic, or granular). Stress–strain curves to fracture were obtained from room-temperature three-point bend tests on planar samples and the mode of fracture was investigated by optical microscopy and electron microfractography. Both the elastic modulus and the fracture stress decreased in progressing from laminar to isotropic granular structures, whereas the fracture strain was highest in the isotropic deposits. Annealing at temperatures between 1700 and 2800°C was found to change greatly the properties of only the high-density laminar structures deposited from high methane concentrations, where the elastic modulus and fracture stress were reduced by annealing. The mechanical properties of the various carbons are discussed in terms of their structure. Author (NSA)

N66-33903# Los Alamos Scientific Lab., N. Mex.
ON THE EFFECTS OF COOLDOWN REQUIREMENTS UPON MISSION APPLICATIONS FOR NUCLEAR ROCKETS
Charles Fenstermacher and Donald T. Oakley (Public Health Serv., Las Vegas, Nev.) [1965] 14 p refs Presented at the 2d AIAA Propulsion Joint Specialist Conf., Colorado Springs
(Contract W-7405-ENG-36)
(LA-DC-7641; CONF-660808-4) CFSTI: HC $1.00/MF $0.50

When considering mission applications for nuclear rockets, one encounters the problem of the delayed energy produced by fission product decay after the full power operation phase. If restarts are not planned for the engine, the problem can be ignored because each engine is jettisoned at the end of its operation. However, if restarts are considered, at least

two aspects of the cooldown problem must be examined. First, the program necessary for safe reactor cooldown and propellant requirements for this and second, the feasibility of producing useful thrust during this cooldown. Studies were made of the cooldown requirements as a function of operating times for mission applications at the NERVA-2 power level and their effects on the specific impulse and vehicle weight. These calculations include realistic limits upon exit gas temperatures imposed by reactor design considerations. The effects upon I_{sp} were studied using as a parameter the fraction of cooldown propellant assumed to produce thrust. The results indicate I_{sp} degradation of 2 to 15 sec and vehicle weight increases of 6,000 to 40,000 lb over the range considered. Author (NSA)

N66-33905 Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

SENSITIVITY OF THERMAL REACTOR PARAMETERS TO SCATTERING MODEL

J. R. Worden, W. L. Purcell, and R. C. Liikala 25 Mar. 1966 7 p refs Presented at the Am. Phys. Soc., Conf. on Neutron Cross Section Technol., Washington, D. C.

(Contract AT(45-1)-1830)

(BNWL-SA-616; CONF-660303-31) CFSTI: HC $1.00/MF $0.50

Comparative studies were carried out to determine the effect of the choice of scattering model for the common moderating materials, H_2O, D_2O, and graphite, on calculated reactor parameters. Calculations of the thermal reproduction factor, $\bar{\eta}$, and the thermal utilization, f, were made for uranium and/or plutonium for which measured values of parameters are available. The calculations were performed using the thermalization code, THERMOS, in conjunction with kernels generated using various scattering models. It is concluded that scattering in graphite is adequately represented by the Parks' kernel if the criterion for adequacy is matching the core parameters, $\bar{\eta}$ and f. This has been confirmed for systems containing uranium only and both uranium and plutonium where, in each case, calculated values of the parameters agree with those measured within the experimental uncertainty. The inadequacy of the free gas model for graphite is exhibited by discrepancies of 1 to 2 percent in the calculated value of f. It is shown that neglecting anisotropic scattering in H_2O leads to large errors in calculated parameters. Results of the study of scattering in D_2O are not conclusive and indicate the need for further study of simpler systems.

Author (NSA)

N66-33923# National Lead Co. of Ohio, Cincinnati. Technical Div.

EFFECT OF ENVIRONMENTAL CONDITIONS ON THE PITTING OF URANIUM

T. R. Kato and D. H. Price Dec. 1965 7 p refs

(Contract AT(30-1)-1156)

(NLCO-957) CFSTI: HC $1.00/MF $0.50

Corrosion pitting of uranium fuel cores during fabrication can be mitigated by controlling the environmental conditions under which they are produced. Mositure, chloride ion concentration, exposure time, and differential aeration were found to be especially important in the control of pitting.

Author (NSA)

N66-33929# General Electric Co., San Jose, Calif.

EXPERIMENTAL STUDIES OF TRANSIENT EFFECTS IN FAST REACTOR FUELS. SERIES III: PREIRRADIATED MIXED OXIDE (PuO_2–UO_2) IRRADIATIONS. STEADY-STATE IRRADIATIONS Interim Report

J. E. Hanson and S. A. Rabin Sep. 1965 135 p refs

(Contract AT(04-3)-189)

(GEAP-4819) CFSTI: HC $4.00/MF $1.00

The irradiation performance of five 0.250-inch-diameter mixed oxide (PuO_2–UO_2) fuel specimens is presented and discussed. The burnup attained by two specimens was about 8000 MWd/T_e. The three remaining specimens attained goal exposures of about 65,000 MWd/T_e. One low burnup and one high burnup specimen were subjected to destructive examinations. The remaining specimens were examined by means of nondestructive techniques prior to a re-encapsulation for transient irradiation. Author (NSA)

N66-33952# General Dynamics Corp., San Diego, Calif. General Atomic Div.

DIFFUSION OF FISSION PRODUCTS (AND TRANSMUTATION PRODUCTS) IN NONFUEL MATERIALS. A Review

M. T. Simnad and L. R. Zumwalt 15 Dec. 1965 186 p refs

(Contract AT(04-3)-187)

(GA-6542) CFSTI: HC $5.00/MF $1.00

A review is presented on the kinetics and mechanism of diffusion of fission products and transmutation products in nonfuel (nonfissile) materials. The topics covered include theoretical studies and the derivation of the diffusion equations, the influence of irradiation damage, and the formation of inert gas bubbles. The materials in which the diffusion processes were studied include dispersion-type fuel bodies, cladding and structural materials, and moderator, reflector, and control materials. These are reviewed under the classifications metallic, ceramic, and carbon materials. The concomitant changes in some other properties as a result of the diffusion of fission products and transmutation products are also discussed. Author (NSA)

N66-33960# Bettis Atomic Power Lab., Pittsburgh, Pa.

SPARK: A FORTRAN IV DIGITAL PROGRAM FOR SUB-POWER ANALYSIS OF REACTOR KINETICS TRANSIENTS

W. G. Clarke Apr. 1966 74 p refs

(Contract AT(11-1)-GEN-14)

(WAPD-TM-424) CFSTI: HC $3.00/MF $0.75

A description is given of a FORTRAN IV digital computer program which numerically solves the conventional point reactor kinetics equations for transients with no feedback reactivity mechanisms. The program is especially useful in describing the dynamic behavior of the first (point kinetics) and second moments (stochastic process) of the neutron population in a reactor during startup from source and intermediate ranges. Special features of the program include simulation of nuclear instrumentation, analysis of intermediate range rate protection, gravity scram, and permissible time variation of basic kinetics parameters. Author (NSA)

N66-33973*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

HEAT-TRANSFER ANALYSIS OF THE PLUM BROOK REACTOR

Harry J. Reilly, Kenneth J. Baumeister, and Salvi Altomare Washington, NASA, Aug. 1966 36 p refs

(NASA-TN-D-3552) CFSTI: HC $2.00/MF $0.50 CSCL 18I

A heat-transfer analysis of the Plum Brook Reactor (PBR) core was performed to determine fuel-plate surface temperatures, heat fluxes, and the departure-from-nucleate-boiling (DNB) ratio during full power operation. The hot-spot–hot-channel method was employed; the heat-flux distributions in the coolant channels were based on the measured low-power neutron-flux distributions in the cold clean core and in cores containing partially depleted elements. A statistical method was employed to determine the effects of engineering uncertainties on the reactor heat transfer. The calculations include the effects of asymmetrical cooling of the fuel plates and fuel lumping at the ends of the fuel plates. A flow coast-down study was performed to determine the required responses

of reactor instrumentation following a loss of the main coolant pumps. The calculations were done for the hot spot located by the steady-state analysis. The results indicate that the analytical methods described give more realistic estimates of the heat-transfer margin during operation at 60 megawatts (thermal) than would be obtained with conventional methods. The observed performance of the reactor indicates that the methods used are sufficiently conservative to ensure the safety of the reactor. Author

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

23

N66-32833# California Univ., Berkeley. Lawrence Radiation Lab.

FIELD ION MICROSCOPE STUDIES OF INTERFACES

S. Ranganathan Mar. 1966 36 p refs Presented at Field Ion Microscopy Conf., Gainesville, Fla.

(Contract W-7405-ENG-48)

(UCRL-16777; CONF-660317-1) CFSTI: HC $2.00/MF $0.50 $0.50

Field ion microscope studies were made on boundaries separating crystals differing only in orientation. Observation of boundaries separating crystals differing in structure and composition is also discussed. Direct evidence for the presence of dislocations at grain boundaries is given and analyzed. Field ion micrographs of high angle grain boundaries showed three types of structures. NSA

N66-32891# Bettis Atomic Power Lab., Pittsburgh, Pa.

X-RAY LINE BROADENING: ITS SOLUTION AND APPLICATION THROUGH THE USE OF DIGITAL COMPUTER

R. M. Berman and O. M. Katz Nov. 1965 19 p refs

(Contract AT(11-1)-GEN-14)

(WAPD-TM-521) CFSTI: HC $1.00/MF $0.50

Computer program MO615 was written to utilize the Fourier transform method to correct broadened X-ray lines for experimental conditions without any assumptions as to peak shape. By comparison to the appropriate standard line no other corrections are needed to directly apply the true diffraction broadening given by the computer. A number of plots are also produced which allow a critical analysis of whether small crystallite size or strain broadening is more prominent. Such an analysis can be done with just one diffracted line. Examples of small crystallite size broadening for a UO_2 product and strain broadening for cold-rolled zirconium foil are included. Author (NSA)

N66-33027# United Kingdom Atomic Energy Authority, Harwell (England). Information Branch.

THE STRUCTURE OF MONATOMIC LIQUID METALS

H. Richter and G. Breitling Jan. 1966 30 p refs Transl. into ENGLISH from Z. Naturforsch. (Tubingen, W. Germany), v. 20a, no. 8, 1965 p 1061–1075

(AERE-TRANS-1051) HMSO: 4s

The Fourier analysis is used to evaluate the intensity curve of liquid metals, and these curves are examined to obtain data on their origin. It is shown that, in the melts of elements with metallic bonds in the lattice, such as Au, Ag, and Al, the first zero point of the $i(s)_{exp}$ curve is determined by twice the interatomic distance $2r_1$ of the plane lattice structure. Conversely, in the melts of elements with homopolar bonds in the lattice, such as Bi, Sb, Ge, and Ga, the first zero point is determined by twice the interatomic distance $2r_1$ of the close-packed structure. In this case, the position of maximum I on the $i(s)_{exp}$ curve is determined by twice the interatomic distance $2r_1$. Tabulated data are presented on the interatomic distances and coordination numbers for the melt and lattice, and interatomic distances of the close packed structure, and the maximum integration lengths. It was concluded that both close packed and plane lattice structures are found in very small regions of the liquie metals, due to the presence of both metallic and homopolar bonds at the same time. M.G.J.

N66-33093 Aix-Marseilles Univ. (France). Fluid Mechanics Inst. of Marseilles.

INTERACTION BETWEEN A MAGNETIC FIELD AND A MOVING IONIZED GAS. STUDY C [INTERACTION D'UN CHAMP MAGNETIQUE ET D'UN GAZ IONISE EN ECOULEMENT. ETUDE C]

J. Valensi, P. Parraud, and G. Inglesakis [1966] 72 p refs In FRENCH

(Contract DRME-65.34.311.00.480.75.01) CFSTI: HC $3.00/MF $0.75

Combustion shock tube studies were made to determine the physical properties resulting from the interaction of a highly ionized plasma (produced by the propagation of a strong shock wave in the argon) in supersonic flow with a transverse magnetic field. When Laplace forces oppose the plasma flow, the following can be concluded: (1) A simplified theory supposing that the plasma flow is one-dimensional, stationary, and in thermodynamic equilibrium accounts for overall satisfactory phenomenon when the interaction is not too strong. (2) In open circuit the tension induced in the flow is clearly equal to the theoretical tension. (3) In closed circuit there is a fall in constant potential which seems to arise from electrical phenomena observed in the plasma in the immediate vicinity of the cathode. (4) The extraction of power involves the formation in the plasma following deceleration of a shock wave, the position and intensity of which, respectively, depend on the duration of the interaction and the total current intensity traversing the plasma and discharged into the outside circuit. Transl. by R. Ll.

N66-33174*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.

AN APPRAISAL OF THE FOPIM FAST-CONVERGING PERTURBATION METHOD

Peter D. Robinson, John H. Huntington, and Joseph O. Hirsch-Felder 19 Nov. 1964 22 p refs Submitted for Publication

(Grant NsG-275-62)

(NASA-CR-59677, WIS-TCI-73) CFSTI: HC $1.00/MF $0.50 CSCL 20J

The practicality of the First-Order-Perturbation-Iteration-Method (FOPIM) is appraised. After the first iteration, the expectation value of the energy is given by a non-analytic function of the perturbation parameter λ. The asymptotic expansion of this function gives the energy accurately up to $O(\lambda^8)$. The convergence of the asymptotic expansions is discussed. Two examples are considered: a perturbed ground state hydrogen atom, and a perturbed ground state linear harmonic oscillator. Author

N66-33178*# National Bureau of Standards, Washington, D. C.

ON THE USE OF THERMOPILES FOR ABSOLUTE RADIOMETRY IN THE FAR ULTRAVIOLET

R. G. Johnston and R. P. Madden [1964] 33 p refs

(NASA Order R-73)

(NASA-CR-64059) CFSTI: HC $2.00/MF $0.50 CSCL 20F

Thermopiles used for absolute radiometry in the far ultraviolet spectral region are generally calibrated with visible and near-infrared radiation. Three possibilities for the failure of the sensitivity of thermopiles to be independent of wavelength have been investigated. It was found that gold-black typical of that used on thermopiles for far ultraviolet applications reflectively scattered 2-4% of the incident far ultraviolet radiation. Since the same gold-black scattered a similar fraction incident visible and near-infrared radiation, the correction for this effect was small. An analysis of surface snesitivity maps indicated that a thermopile of 0.04 sec time constant showed no wavelength variation of sensitivity when either d.c. detection or a.c. synchronous detection with 13 c/s chopping was used. The most significant wavelength-dependent phenomenon of importance was found to be the photoelectric effect. Ejected electrons carry a significant amount of energy away from gold-blacked thermopiles in the spectral region below 1600 Å. The maximum correction determined for a particular thermopile was 5.2% at 735 Å. Author

N66-33238# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

DERIVATION OF A GENERALIZED FUNCTION OF THE WAVE HEIGHT DISTRIBUTION OF THE SURFACE OF A HEAVY LIQUID

I. S. Brovikov 26 Apr. 1966 16 p refs Transl. into ENGLISH from Tru. Okeanogr. Komis., Akad. Nauk SSSR (Moscow), no. 42, 1958 p 105-114

(Contract NOw-62-0604-c)

(TG-230-T472; AD-633635) CFSTI: HC $1.00/MF $0.50

The author discusses the adequacy of visual, semi-instrumental, and instrumental methods for observing wind wave elements. This is followed by an examination of the statistical characteristics of the height and period deep sea waves obtained by instrumental observations and of the statistical characteristics of wind-induced waves obtained theoretically. Author

N66-33252# Weidlinger (Paul) Consultants, New York. Thermal Ballistics Lab.

STRESSES IN AN ELASTIC-PLASTIC HALF-SPACE DUE TO A SUPERSEISMIC STEP LOAD

Alva T. Matthews and Hans H. Bleich Mar. 1966 73 p refs

(Contract DA-30-069-AMC-8(R))

(TR-4; AD-633776) CFSTI: HC $3.00/MF $0.75

The plane strain problem of a step load moving with uniform superseismic velocity $V > c_p$ on the surface of a half-space is considered for an elastic-plastic material obeying the von Mises yield condition. Using dimensional analysis the governing quasi-linear partial differential equations are converted into ordinary nonlinear differential which are solved numerically using a digital computer. To overcome computing difficulties asymptotic solutions are derived in the vicinity of a singular point of the differential equations. Numerical results are presented for a range of selected values of significant nondimensional parameters, i.e., of the surface load p_0/k of Poisson's ratio ν and of the velocity ratio V/c_p. Author (TAB)

N66-33364# Watervliet Arsenal, N. Y. Benet Labs.

THE MUTUALITY OF STATIC AND KINETIC FRICTION

Thomas E. Simkins Apr. 1966 22 p refs

(WVT-6611; AD-633985) CFSTI: HC $1.00/MF $0.50

An experiment was performed, the object of which was to observe directly the dependence of static friction force magnitudes upon the static contact time. Not only was there a complete lack of evidence that such a time-dependency exists, but in addition there were no static or starting friction forces which were observed to be greater than all the forces observed during subsequent sliding contact. A possible explanation for the contrary observations is given and is supported by results of a second experiment in which extensive sliding contact on a microscopic scale was observed prior to gross (visible) sliding. Author (TAB)

N66-33377*# Naval Research Lab., Washington, D. C. E. O. Hulburt Center for Space Research.

POLARIZERS FOR THE EXTREME ULTRAVIOLET

W. R. Hunter Aug. 1964 22 p refs Presented at the Conf. on Phot. and Spectroscopic Optics, Tokyo and Kyoto, Japan, 1-8 Sep. 1964 Submitted for Publication

(NASA Order R-107)

(NASA-CR-59934) CFSTI: HC $1.00/MF $0.50 CSCL 20F

The polarizing properties of materials in the extreme ultraviolet are being studied for the purpose of developing both reflecting and transmitting polarizers. Calculations of the ratios $R_s/R_p = \rho$ and $T_p/T_s = 1/\rho$ have been made for some of those materials whose optical constants have been measured and an attempt was made to verify the calculated ratios experimentally where possible. The calculations indicate the possibility of making transmitting polarizers, using multilayer unbacked metal films, for wavelengths less than the critical wavelength of the metal. The calculated value of $1/\rho$ for Au/Al/Au at 640 Å and $i = 42°$ was found to be 15, but T_p for this multilayer film, is only a few percent. Reflecting polarizers, which are much less convenient to use, show more complete polarization. For example, for Au/Al/Glass at 640 Å $\rho = 35$ at $i = 62°$, and $R_s = 30\%$. Author

N66-33380*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.

DIFFERENT SCREENING CONSTANTS FOR DIFFERENT PHYSICAL PROPERTIES. I

Joseph O. Hirschfelder and William A. Sanders 13 Nov. 1964 45 p refs Submitted for Publication

(Grant NSG-275-62)

(NASA-CR-59876; WIS-TCI-71) CFSTI: HC $2.00/MF $0.50 CSCL 20J

Expectation values of properties other than energy are calculated for the ground state of the two-electron atom with arbitrary nuclear charge. The calculations are designed to test the use of simple wave functions with embedded screening constants, where different screening constants are used for different properties. The results are compared with the perturbation expansion of Scherr and Knight, who have determined a large number of properties correct through sixth order. Author

N66-33383*# Michigan Univ., Ann Arbor. Radiation Lab.

HUYGEN'S PRINCIPLE IN A MOVING ISOTROPIC HOMOGENEOUS AND LINEAR MEDIUM

Chen-To Tai 21 Oct. 1964 11 p refs Presented at the 1st Natl. Electron. Conf., Sao Jose dos Campos, Brazil, 4-9 Jan. 1965

(Grant-NsG-444)

(NASA-CR-59829; RL-283) CFSTI: HC $1.00/MF $0.50 CSCL 20N

This work contains an analytical description of Huygen's Principle for an electromagnetic field in a moving isotropic,

homogeneous and linear medium. By starting with Maxwell-Minkowski equations it is possible to construct a combined field equation in the manner of Bateman and Itoh. The resultant equation is then integrated with the aid of an appropriate dyadic Green's function which can be found by means of the operational method originally due to Levine and Schwinger. Author

N66-33409*# Alabama Univ. Research Inst., Huntsville.
APPROXIMATE METHODS FOR THE COMPUTATION OF WAVE PROPAGATION IN NONUNIFORM MEDIA Interim Report No. 1
1 Sep. 1964 27 p refs
(Grant NsG-608)
(NASA-CR-59569) CFSTI: HC $2.00/MF $0.50 CSCL 20N

Approximate methods for the computation of propagation of plane waves through a nonuniform dielectric slab, scattering by a nonuniform dielectric cylinder, and a conducting cylinder surrounded by a nonuniform dielectric are considered. The differential equations involved can be solved by Taylor's method, by the method of collocation, and by the method of least squares for this prupose. The dielectric slab of exponentially varying permittivity is being treated by both the rigorous and the approximate methods. The results of the approximate method are being compared with the rigorous solutions for obtaining an indication of the accuracy of the approximations. Author

N66-33420*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
SOME REMARKS ON THE USE OF THE VARIATIONAL PRINCIPLE FOR THE SECOND ORDER ENERGY
Jean H. Epstein and Saul T. Epstein 16 Nov. 1964 8 p refs Submitted for Publication
(Grant NsG-275-62)
(NASA-CR-59726; WIS-TCI-72) CFSTI: HC $1.00/MF $0.50 CSCL 20J

An approximate ground state wave function is used in the familiar variational principle for the second-order energy. It is demonstrated that the approximate energy need have no special relationship to the exact energy (it may be larger or smaller). Further it is shown that in some cases even with full use of the variation principle, good accuracy of the ground state wave function does not imply corresponding accuracy of the approximate energy. Author

N66-33472# California Inst. of Tech., Pasadena, Calif. Div. of Engineering and Applied Science.
ECHOES FROM HOLLOW ALUMINUM SPHERES IN WATER
K. Jerome Diercks and Robert Hickling Mar. 1966 42 p refs
(Contract N60530-12065)
(Rept.-122.2; AD-634546) CFSTI: HC $2.00/MF $0.50

Recorded far-field echoes from precision hollow aluminum spheres in water, with different shell thicknesses and with either water or air in the hollow interior, are compared with calculated echoes. Steady state echoes are investigated over a range of ka from 6 to 27, and individual pulsed echoes at ka=20. Excellent veritication is obtained for the features predicted by the theory. It is shown that the echoes are sensitive to changes in the elastic properties of the shell, particularly when the shell is thin. The experiments showed moreover that the echoes are dependent on the orientation of the sphere. This is due presumably to asymmetries in the structure and properties of the shell and emphasizes again the strong interrelation between sonar echoes and the nature of the material in the target. Author (TAB)

N66-33581# Lockheed Missiles and Space Co., Sunnyvale, Calif.
NUMERICAL INVESTIGATION OF ELECTROMAGNETIC SCATTERING AND DIFFRACTION BY CONVEX OBJECTS Final Report, 16 Nov. 1964–15 Nov. 1965
Nelson A. Logan Dec. 1965 708 p refs
(Contract AF 19(628)-4393)
(AFCRL-66-153; M-76-66-1; AD-634070) CFSTI: HC $10.50/MF $3.00

The solutions $D(x,y,y_{o,q})$ of the partial differential equation $D_{yy}+iD_x+yD = 0$ are employed as a mathematical model for the fields reflected from and diffracted around an opaque convex surface. This solution involves the Airy function $w_1(t_s) - qw_1$ surface. This solution involves the Airy function $w_1(t)$ which is a solution of $tw_1''(t) - tw_1(t) = 0$. Fortran computer programs and tables are given for the appropriate Airy functions. Representations for the roots of the equation $w'_1(t_s) - qw_1(t_s) = 0$ which play a fundamental role in the theory are discussed. As as function of q, these roots satisfy the Riccati equation $(t - q^2)(dt/dt) = 1$. The Riccati equation is used to develop several representations for these roots. Fortran programs are presented for the evaluation of these constants. Tables of the roots are given for certain cases which is a solution of $F'(y) + [k^2f(y) - \lambda_s]F(y) = 0$. The theory of representing functions by a series of Chebyshev polynomials is reviewed and a discussion is given of the significance of these expansions for future work in diffraction theory Author (TAB)

N66-33608# Stanford Univ., Calif. Dept. of Physics.
COMPARISON OF THEORY AND OBSERVATION IN GENERAL RELATIVITY
L. I. Schiff [1966] 20 p refs
(Contract AF 49(638)-1389)
(ITP-181; AD-632843) CFSTI: HC $1.00/MF $0.50

The report consists of an abbreviated version of two lectures whose purpose was: (a) to stress the care that must be taken in comparing predictions of general relativity with observations; and (b) to describe a quantitative method for determining the extent to which one particular but important aspect of the theory is being tested. TAB

N66-33643# Institute of Modern Languages, Inc., Washington, D. C.
CRYSTALLINE OPTICS. EXPERIMENTAL STUDY OF PLANE ELECTROMAGNETIC WAVES WHICH PROPAGATE THROUGH A HELICOID NEMATIC PLATE
M. Jean Billard Mar. 1966 8 p refs Transl. into ENGLISH from C. R. Acad. Sci. (Paris), v. 261, 26 Jul. 1965 939 p
(Contract DA-44-009-AMC-1563(T))
(ERDL-T-1844-66; AD-632676) CFSTI: HC $1.00/MF $0.50

An experimental study of plane electromagnetic waves that propagate through a helicoid nematic plate is presented. In contradiction to the Airy hypothesis, principle luminous nonorthogonal vibrations are demonstrated experimentally through a polarizing microscope of helicoid nematic plates obtained in a cleavage area. S.P.

N66-33648# Brandeis Univ., Waltham, Mass. Dept. of Chemistry.
TIME-SMOOTHED ASPECTS OF RATE AND CROSS-SECTION MEASUREMENTS
Sidney Golden and Ronald H. Felton 15 May 1966 28 p refs
(Contract Nonr-1677(01))
(TR-17; AD-633837) CFSTI: HC $2.00/MF $0.50

The measurement aspects of experiments designed to yield information about rates at which certain processes occur in a system, as well as their relevant cross-sections, are dis-

cussed. As a closer approximation to experimental quantities, their time-smoothed theoretical counterparts are dealt with. The asymptotic behavior of these quantities, as the interval of time-smoothing becomes indefinitely large, are examined. In the long-term time averaged sense, it is shown that cross sections computed from transition probabilities or rates of change of transition probability yield equivalent results in the limit of the system approaching a zero value of its density. The equivalence of the cross section based upon a stationary state formalism is also established. The formal equivalence holds for many-particle systems. Author (TAB)

N66-33651# Stanford Univ., Calif. Dept. of Mathematics.
VARIATIONAL PRINCIPLES IN POTENTIAL THEORY
Harold Levine 28 May 1965 29 p refs
(Contract Nonr-225(74))
(TR-5; AD-616095) CFSTI: HC $2.00/MF $0.50

Although the theoretical and practical importance of variational techniques in potential theory has long been secure, fresh instances of their utility are not without interest. Two cases in point are detailed, one relating to the capacitance of a condenser formed by a centrally placed strip within a circular shell and the other relating to the torsional rigidity of a circular cylindrical bar with a radial slit. The high degree of geometrical symmetry reflected in these configurations affords a corresponding diversity in approaches to the concomitant boundary value problems; and it is noteworthy that the exercise of different procedural options furnishes variational characterizations with a complementary nature. Thus, in the foregoing examples, a pair of newly devised variational principles are shown to provide opposite bounds for the capacitance and torsional rigidity, respectively, from those associated with alternative (though more readily established) principles. It appears, furthermore, that the new variational formulations are especially suited to the circumstances wherein the larger values of the ratio of the strip, or slit, width to the circular diameter obtain, whereas the others enjoy a corresponding fitness if the ratio is small compared with unity. Author (TAB)

N66-33698*# National Aeronautics and Space Administration, Washington, D. C.
OPTIMAL CONDITIONS OF DECELERATING THE ROTATIONAL MOTION OF A SYMMETRIC BODY [OPTIMAL'NYYE REZHIMY TORMOZHENIYA VRASHCHATEL'NOGO DVIZHENIYA SIMMETRICHNOGO TELA]
B. A. Smol'nikov May 1966 23 p refs Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), v. 28, no. 4, 1964 p 725-734
(NASA-TT-F-10140) CFSTI: HC $1.00/MF $0.50 CSCL 22A

The problem of determining the optimum operating conditions of a torque-producing jet engine during deceleration of the angular velocity of a symmetric rigid body, executing originally free motion in space about its own center of inertia, is mathematically analyzed. Braking within minimum time and braking at minimum consumption of the working medium are calculated at controlling moments of limited magnitude. Optimum phase trajectories of the body, for both cases, are derived. Author

N66-33812# Marine Engineering Lab., Annapolis, Md.
RADIATED SOUND FROM A CLAMPED CIRCULAR PLATE EXCITED IN THREE DIRECTIONS
Forrest J. Agee, Jr. and William J. Meggs June 1966 43 p refs
(MEL-181/66; AD-633991) CFSTI: HC $2.00/MF $0.50

An experimental and theoretical study of the sound radiated from a centrally driven clamped circular plate was performed to gain information about the acoustic transfer function of this model. This was a phase of a study of parameters which influence the radiated sound due to a vibration source mounted inside a ship hull. The relative acoustic importance of vibrational force and torque inputs was investigated for three principle directions: normal to the plate, parallel to the plate, and rotationally flexing the plate. The experimental results indicated that contributions from motion in the plane of the plate were negligible. At low frequencies, the normal input direction was dominant, but the rotational input became more important at higher frequencies (above 1000 cps for this model). The theoretical treatment yielded the velocity distribution over the plate for the modes excited by a normal drive and the near and distant radiated sound fields. The solutions were integrated numerically for points on the axis of the plate. The ratio of the axial far-field to near-field radiated sound was computed to permit deducing the far-field acoustic transfer function from near-field data. Author (TAB)

N66-33845# Polytechnic Inst. of Brooklyn, Farmingdale, N. Y. Dept. of Electrophysics.
RADIATION AND DIFFRACTION OF ELECTROMAGNETIC FIELDS IN ANISOTROPIC MEDIA
Shalom Rosenbaum 25 Feb. 1966 215 p refs
(Contract AF 19(628)-2357)
(PIBMRI-1320-66; AFCRL-66-255; AD-633726) CFSTI: HC $6.00/MF $1.25

This work deals with the radiation from two-dimensional time-harmonic source distributions embedded in a transversely unbounded region filled with a uniaxially anisotropic medium; the optic axis is permitted to be inclined at an arbitrary angle with respect to the z-direction of stratification. The problem incorporates non-reciprocal effects with respect to the z-axis (lack of reflection symmetry) as well as mode coupling at planar discontinuities and in the source region. Three types of discontinuities are considered: (a) perfectly conducting infinite plane, (b) a dielectric interface, (c) a perfectly conducting half plane. A guided mode technique is employed for the rigorous analysis of the boundary value problems, and special attention is paid subsequently to the asymptotic (short wavelength) limit which enables one to extract from the exact results invariant, ray-optical forms. Since the range of validity of the latter is broader than the special class of configurations from which they are derived. An extensive and direct use of ray techniques is suggested in more general anisotropic environments. TAB

N66-33928# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Atomnoi Energii.
INVESTIGATION OF HIGH CURRENT INLET INTO LIQUID HELIUM [ISSLEDOVANIE SIL'NOTOCHNYKH VVODOV V ZHIDRII GELII]
V. E. Keilin and E. Yu. Klimenko [1965] 24 p refs In RUSSIAN
(IAE-1007)

The conditions for the decrease of the speed of evaporation, dependent on the introduction, of high-flow liquid helium were investigated experimentally and theoretically. Inlets, cooled with evaporating helium, were examined basically. The calculations made and the experimental results were in good agreement. They indicate the weak dependence of the evaporation speed on the temperature of the thermal end of the outlet and on its geometric dimensions. A quantitative advantage was derived from the utilization of combined inlets (superconductors in good thermal and electrical contact with normal metals). Author (NSA)

N66-33982*# Celestial Research Corp., South Pasadena, Calif.
EXPERIMENTAL INVESTIGATIONS OF SOLID NITROGEN FORMED BY CRYOPUMPING
K. W. Rogers Washington, NASA, Aug. 1966 47 p refs
(Contract NASw-1282)
(NASA-CR-553) CFSTI: HC $2.00/MF $0.50 CSCL 20M

An experimental investigation was made to determine the density, thermal conductivity and sticking coefficient of the nitrogen condensate formed on a cryopump. The cryopump temperature was in the range of 15° to 26°K and the incident gas temperature was 79°K. Neither the density nor the thermal conductivity were significantly influenced by the deposition rate over the range of gas pressure ($2 \times 10^{-4} < P < 10^{-3}$ torr. The measured density was about .90 gm/cc and the measured thermal conductivity was about 1.2 mW/cm-°K. The sticking coefficient varied with the cryopump temperature and the thickness of the condensate layer. The values of the sticking coefficient varied from about .85 to 1.0. Author

N66-34063# Naval Applied Science Lab., Brooklyn, N. Y.
ANECHOIC COATING PROJECT REPORT ON THE DETERMINATION OF ACOUSTIC PROPERTIES OF MATERIALS BY PROPAGATION OF WAVES IN WATER FILLED TUBES Progress Report
Jean Mariani [1965] 63 p refs
(PR-1; AD-634203) CFSTI: HC $3.00/MF $0.75

The first part concerns itself with the development of the wave equation in its general form. In order to apply the wave equation to the analysis of sound waves in water filled tubes. The equation is converted from Cartesian to cylindrical coordinates. It is then shown that the wave equation is separable and that its solution may be represented as the product of four distinct functions, each related to only one variable. The general solution to the wave equation is then shown to be a complex waveform being simultaneously propagated along the longitudinal and radial axes of the tube as well as in the β-space. It is shown that the wave equation reduces to a plane wave, that is, one which is propagated along the longitudinal axis of the tube only. It is further shown that, as the radial waves form a discontinuous series of frequencies. A certain minimum frequency must not be exceeded in order to maintain plane monochromatic waves. The final part deals with the application of theory to sound waves in water filled tubes. TAB

N66-34067*# Illinois Univ., Urbana. Coordinated Science Lab.
RESEARCH RELATED TO AN EXPERIMENTAL TEST OF GENERAL RELATIVITY Semiannual Status Report, 1 Jan.-30 Jun. 1966
H. Knoebel and D. Alpert Jul. 1966 29 p refs
(Grant NsG-443)
(NASA-CR-77108) CFSTI: HC $2.00/MF $0.50 CSCL 20J

Materials for gyros which have acceptable electrical resistivity within the high temperature limits and high mechanical damping were investigated. A digital computer program was written to determine typical times of observation of a sunlight-illuminated satellite, and preliminary results show that for an equatorial orbit of 1000 km altitude, an average of three observations a day may be possible. The work on gas dray was extended to include the effects of nonuniform heating and orbital regression. A degeneracy of mirror-normal-to-spin-axis angles, from the mirror configuration using mirrors identified as the facets of a truncated icosahedron, and removal of the degeneracy by using a tetrahedron or a flattened sphere are discussed. Photographic observability, accuracy, and interpretation, are reviewed. A computer simulation of film noise and photographic simulation are reported. N.E.N.

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N66-32696*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PHOTOIONIZATION CROSS SECTIONS FOR C^-, N AND O^+
Ronald J. W. Henry Nov. 1965 14 p refs Submitted for Publication
(NASA-TM-X-55405; X-641-65-487) CSCL 20H

Photoionization cross sections for N and O^+ for energies <10 ryd., and for C^- for energies <5 ryd., are calculated using the Hartree–Fock approximation for the final states of transitions involving the ejection of an electron from the configuration $1s^2 2s^2 2p^3 (^4S)$. Author

N66-32708# Massachusetts Inst. of Tech., Cambridge.
THE SPIN DEPENDENCE OF ATOMIC MULTIPLET-ENERGIES IN THE AVERAGED FREE-ELECTRON APPROXIMATION
P. De Cicco *In its* Solid-State and Mol. Theory Group 15 Apr. 1966 p 4-8 refs (See N66-32707 19-26) CFSTI: HC $3.00/MF $0.50

The spin dependence of atomic multiplet energies in the averaged free electron approximation is described. It is concluded that the spin-dependent $P^{1/3}$ approximation gives a reasonable spin dependence for the energies of the multiplets considered although these results can only be semi-quantitative because of the large S-independent splittings. It is pointed out that the advantage of the spin dependent P^{13} energy formula should be greater in solids where a simple, straightforward alternate description is not available. R.U.

N66-32711 Massachusetts Inst. of Tech., Cambridge.
A NOTE ON THE USE OF THE NOUMEROV METHOD IN APW CALCULATIONS
P. De Cicco and A. Kitz *In its* Solid-State and Mol. Theory Group 15 Apr. 1966 p 20-23 refs (See N66-32707 19-26) CFSTI: HC $3.00/MF $0.50

The radial Schroedinger equation is solved in an APW calculation by applying the Noumerov method; a two-term recursion formula is yielded. The radial mesh used is expressed for such calculations using a potential derived from atomic structure calculations, and energies introduced by the coarseness of the mesh are all positive. The radial Schroedinger equation was integrated outward and the energy was varied to the exact boundary condition of asymptotic approach to zero as $r \to \infty$. Data are included on breakdowns of the Noumerov method at both small and large r. R.U.

N66-32712# Massachusetts Inst. of Tech., Cambridge.
VARIATIONAL EXPRESSION FOR THE ENERGY OF A RELATIVISTIC ELECTRON
R. Gilmore *In its* Solid-State and Mol. Theory Group 15 Apr. 1966 p 24-29 refs (See N66-32707 19-26) CFSTI: HC $3.00/MF $0.50

Discussed are the Dirac equation in spherical coordinates solved for a spherically symmetric potential V(r) in the vicinity of a nucleus, and a variational expression for relativistic energy eigenvalues with discontinuous relativistic wave functions. Derived is the variational expression for a relativistic electron. R.U.

N66-32714# Massachusetts Inst. of Tech., Cambridge.
NOTE ON THE BIPOLAR EXPANSION OF $1/r_{12}$
D. E. Ellis *In its* Solid-State and Mol. Theory Group 15 Apr. 1966 p 46–47 refs (See N66-32707 19-26) CFSTI: HC $3.00/MF $0.50

Computer programs were written for two center Coulomb <AA|BB>> and four center <AB|CD> integrals. For the <AA|BB> integrals the infinite series truncate and good agreement with previous programs is obtained. Test values of some combinations of s and p orbitals are in excellent agreement with existing four center programs. It is concluded that the bipolar expansion of $1/r_{12}$ allows efficient and accurate computation of certain multicenter integrals, particularly of the bipolar type. It is pointed out that this result contradicts conclusions based on a study of the bipolar expansions using generalized hypergeometric functions. R.L.

N66-32726*# College of William and Mary, Williamsburg, Va. Dept. of Physics.
INTERMEDIATE ENERGY PHYSICS, VOLUME I
Feb. 1966 515 p refs Proc. of a Conf. held at Williamsburg, Va., 10–12 Feb. 1966
(Grant NsG-567)
(NASA-CR-76991) CFSTI: HC $5.65/MF $2.50 CSCL 20H

Symposium papers on protons, pions and muons in the intermediate energy range are presented. For individual titles see N66-32727–N66-32754.

N66-32727*# Chicago Univ., Ill. Enrico Fermi Inst.
EFFECTS ON NUCLEAR STRUCTURE IN MU-ATOMIC SPECTRA
H. L. Anderson, R. J. Mc Kee, C. K. Hargrove, and E. P. Hincks (Natl. Res. Council of Canada) *In* Coll. of William and Mary Intermediate Energy Phys., Vol. I Feb. 1966 p 1–14 ref (See N66-32726 19-24) CFSTI: HC $5.65/MF $2.50

Studies on mu-mesic X-rays measurements are reviewed, and it is pointed out that the development of the Li-drift Ge-detector improved the resolution by a factor of 10 or more over sodium iodide. The usefulness of the moon in exploring the shape of the nuclear charge distribution is discussed, with emphasis placed on the additional detail which is obtainable in the muonic X-ray analysis. Various experiments are described, and figures depict the spectra obtained in several transitional regions. Results obtained for the four nuclei—Au 197, Pb 206 and 208, and Bi 209—are summarized, and the data are interpreted in terms of the two parameters of the Fermi type of nuclear charge distribution. Graphs are included to show how the dynamic quadrupole effect reveals itself in thorium. Analytical data for Bi is also plotted in terms of a static quadrupole moment. M.G.J.

N66-32728*# Columbia Univ., New York.
HIGH RESOLUTION MUONIC X-RAY STUDIES
S. Devons *In* Coll. of William and Mary Intermediate Energy Phys., Vol. I Feb. 1966 p 15–36 (See N66-32726 19-24) CFSTI: HC $5.65/MF $2.50
(Contracts AT(30-1)GEN-72; Nonr-266(72))

Problems ranging from muonic X-rays in carbon to those in uranium are surveyed, and a listing is presented of the features which indicate the relative importance of real high resolution, precision, and accuracy. Experiments are described in which Li-drift Ge-detectors of about 7 cm^3 were used. To exploit the high resolution of these detectors, single or separated isotopes are used. Graphical data show an analysis of a deformed nucleus, W^{182}, which has a sizable quadrupole moment; isotope effect in K X-rays of Nd^{142}, Nd^{144}, and Nd^{148}; Bi^{209} lines and a calibration line of O^{16} at 6.13 MeV; L X-rays of Bi^{209}; and U^{238} muon X-rays. Experimental and theoretical U^{238} K X-ray energy differences are compared, and optical isotope shifts are plotted to show variation with the theoretical fit using the $A^{1/3}$ law. M.G.J.

N66-32729*# Illinois Univ., Urbana. Dept. of Physics.
REMARKS ON THE THEORY OF MU-MESIC ATOMS
D. G. Ravenhall *In* Coll. of William and Mary Intermediate Energy Phys., Vol. I Feb. 1966 p 37–49 refs (See N66-32726 19-24) CFSTI: HC $5.65/MF $2.50
(Contract NSF G-17428)

Several comments are offered on the basic model for the mu-mesic atom calculations, which represents the nucleus as a charge distribution, and the meson as a Dirac particle which interacts through the Coulomb interaction. The level of accuracy beyond which a more refined description of the nucleus may be needed is assessed. Calculation of the vacuum polarization contribution to energy shifts is discussed, and the large correction necessitated by vacuum polarization is explained. The neglect of nuclear polarization in replacing the nucleus by a static, perhaps deformed, charge distribution is identified as the largest contributor to uncertainties in theoretical predictions. As this same approximation is made in electron–nucleus scattering, the results obtained from the two methods are compared. M.G.J.

N66-32730*# Argonne National Lab., Calif.
X-RAYS FROM MUONIC ATOMS WITH SPHERICAL OR NEARLY SPHERICAL NUCLEI. STUDIES OF MUONIC ATOMS OF NON-SPHERICAL NUCLEI
R. E. Cote', W. J. Prestwich, S. Raboy, C. C. Trail, R. A. Carrigan, Jr. et al *In* Coll. of William and Mary Intermediate Energy Phys., Vol. I Feb. 1966 p 51–75 (See N66-32726 19-24) CFSTI: HC $5.65/MF $2.50

Experimental data obtained from muonic X-ray studies are discussed, and some details are given on plans for interpreting these data. The K X-rays from Pr^{141} are shown as an example of a simple spectrum; the more complex spectra for nuclides with large quadrupole moments are also depicted. These include the K X-ray spectra of muonic Ho^{165}, Tb^{159}, natural cerium, indium, and iodine; and the L X-ray spectra of indium and iodine. Two heavy nearly spherical nuclides, Au^{197} and Bi^{209}, are also examined. Studies on the capture gamma ray spectrum are reported, and details are given on the muonic X-ray spectrum of bismuth. M.G.J.

N66-32731*# Chicago Univ., Ill.
MEASUREMENTS OF THE M1 AND E2 MUONIC h.f.s. OF Bi^{209}, AND OF THE MUONIC ISOTOPE SHIFTS FOR Pb^{206}, Pb^{207} AND Pb^{208}
T. L. Telegdi *In* Coll. of William and Mary Intermediate Energy Phys., Vol. I Feb. 1966 p 77–86 (See N66-32726 19-24) CFSTI: HC $5.65/MF $2.50

The muonic hyperfine structure in bismuth 209, and the muonic isotopic shifts in the lead isotopes 206, 207, and 208 were studied by bombarding a variety of targets simultaneously with a single muon beam and by tagging the stopping muons according to the target which they hit. Both, prompt muonic X-rays and delayed captured gamma rays were measured for every photon event by pulse height and time history. The summary of Bi data showed solid evidence for finite magnetization; a preference for 0.45 barns, for the quadrupole moment of Bi^{209} was indicated. A superposition of the muonic $K\alpha_1$ lines from the lead isotopes 206, 207, and 208 showed very clearly the shifts from one isotope to the next. Comparison of obtained results with corresponding theoretical values as computed under assumption of the $A^{1/3}$ law showed good agreement with the (206–207)/(208–208) ratio calculated from optical data. G.G.

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N66-32732*# Heidelberg Univ. (West Germany).
THE ANOMALOUS INTENSITY RATIOS IN MUONIC LEAD AND BISMUTH
Jorg Huefner *In* Coll. of William and Mary Intermediate Energy Phys., Vol. I Feb. 1966 p 87–90 refs (See N66-32726 19-24) CFSTI: HC $5.65/MF $2.50

The differences in expected and experimentally obtained values for the Pb and Bi muonic X-ray energy intensity ratios of 1.9, respectively 1.5, were analyzed by tracing the muonic atoms as they cascaded from energy level to energy level, emitting γ-radiation and Auger electrons. The Auger and radiative transitions were calculated with nonrelativistic wave functions and the intensity ratio was evaluated for each state with quantum numbers n and 1 ($n \leq 14$, $1 \leq n-1$) into which the free muon could be captured. Results showed that if the muon was captured into 1=0 or 1=1, a strong 2s→2p and a weak 3d→2p transition should result. G.G.

N66-32733*# Virginia Univ., Charlottesville.
MUONIC X-RAY SPECTRA AND CHARGE DISTRIBUTION IN DEFORMED NUCLEI +
H. L. Acker *In* Coll. of William and Mary Intermediate Energy Phys., Vol. I Feb. 1966 p 91–98 refs (See N66-32726 19-24) CFSTI: HC $5.65/MF $2.50

Calculations on muonic high frequency spectra to obtain the charge distribution of deformed nuclei centered on the two parameters of the radial matrix elements of F(r) with the muonic 2p and 3d wave functions. Since the ratio of the 2p and 3d matrix elements was not affected by Q uncertainties, a generalized Fermi distribution that gave the radial parameter and the surface thickness an angular dependence was utilized to obtain the shape parameter γ values for the equal charge density lines of the U^{238} nucleus with Q = 11 barn. Comparison of muon probability density values for the $2p_{3/2}$ and $3d_{3/2}$ states showed that the ratio of the 2p to the 3d matrix elements was very sensitive to the shape parameter γ; an accuracy of 1% in the ratio yielded an uncertainty of ± 0.5 in charge distribution shape factor. For U^{238} a value of $\gamma \approx 0^5$ was obtained, i.e. a charge distribution where the surface thickness did not vary with angle. Another calculation using multiple expansion methods with a Fermi distribution for the monopole part and a Gaussian for the quadrupole distribution was not successful. G.G.

N66-32734*# European Organization for Nuclear Research, Geneva (Switzerland).
MUONIC X-RAY STUDIES OF SPHERICAL NUCLEI
C. Daum, G. Backenstoss, J. C. Sens, S. A. de Witt, and H. L. Acker (Freiburg Univ., W. Germany) *In* Coll. of William and Mary Intermediate Energy Phys., Vol. I Feb. 1966 p 99–133 (See N66-32726 19-24) CFSTI: HC $5.65/MF $2.50

A flux of 50000 sec^{-1} negative muons from a stochastically operated 600 mev synchrocyclotron together with a Ge(Li) detector was utilized to obtain measurements on isotopic Cl, Ca, Fe, on all nuclei between Sn and Nd (except xenon), and on all nuclei between Au and Bi. A sample of Pb^{206} was also investigated. Except for the three lightest nuclei, 2p→1s and 3d→2p spectra were measured as well as many spectra of higher transitions together with captured gamma rays. All measured transition energies and calibration lines used are shown in tables. Theoretical analyses showed good agreement with 4f–3d and higher transition energies. E_1 transition intensities for all nuclei between Sn and Nd agreed with a statistical population of the muonic levels, except in the 2p—1s transitions of I and Nd. Deformed nucleic measurements for fourteen elements between Sn and Pu were compared with a modified c-model and hard core model for the deformed charge distribution, and a list of transition energies and intensities was obtained. Preliminary fits to muonic X-ray data obtained for both models showed almost the same unperturbed energies. G.G.

N66-32735*# Columbia Univ., New York.
DETAILED ANALYSIS OF MUONIC X-RAY SPECTRUM FROM STRONGLY DEFORMED e-e NUCLEI
K. Runge, T. T. Bardin, R. Barrett, S. Devons, D. Hitlin et al *In* Coll. of William and Mary Intermediate Energy Phys., Vol. I Feb. 1966 p 135–143 refs Supported in part by AEC and ONR (See N66-32726 19-24) CFSTI: HC $5.65/MF $2.50

Muonic X-ray measurements on the tungsten isotopes $W^{182, 184, 186}$ on U^{238}, and on Sm^{152} were analyzed for their dynamic E2 interaction to obtain information about quadrupole moments of deformed nuclei. Intrinsic quadrupole moments of deformed nuclei. Intrinsic quadrupole moments measured by coulomb excitation were utilized to define the radial matrix element of the first excited state of the nuclei; added neutron values then reduced the radial matrix elements as the nuclei became more spherical. Calculations of various charge distributions in order to find f(r) for the nuclei showed good agreement with experimental values if the experimentally known quadrupole moments and the energy of the first excited state were used as input data to calculate the radial matrix element. G.G.

N66-32736*# California Univ., Berkeley.
PI-MESIC X-RAYS
K. M. Crowe *In* Coll. of William and Mary Intermediate Energy Phys., Vol. I Feb. 1966 p 145–173 (See N66-32736 19-24) CFSTI: HC $5.65/MF $2.50

An improved 7.7 curved quartz spectrometer, utilizing a sodium iodide crystal, was developed and used to obtain pi-mesic X-rays of Ca, Ti, and Al energy shift spectra for the s, p, d, and f states. Two measurements of the 4f–3d transition in both Ca and Ti showed a difference between the pi and mu mass of M=139.577±.014 mev. The Al 3d–2p transition at 87 keV showed a net discrepancy of 244±80 volts after correctional calculations. G.G.

N66-32737*# California Univ., Berkeley.
POLARIZATION IN PION–PROTON SCATTERING
P. D. Grannis *In* Coll. of William and Mary Intermediate Energy Phys., Vol. I Feb. 1966 p 175–186 (See N66-32726 19-24) CFSTI: HC $5.65/MF $2.50

A cyclotron pion beam incident on a polarized stack of crystals, in which only the free protons in the waters of hydration were polarized, was utilized to measure the polarization parameter in negative pion–proton scattering for the energy region of 1 BeV and lower. Results at 323 MeV from cyclotron measurements of the Π^-p polarization showed a maximum near the center of the mass scattering angle of .58, in agreement with phase shift resolutions; preliminary results for the Π^- p backward angle polarization in the vicinity of the 600 MeV resonances established a pronounced peak near 180° that broadened and shifted toward smaller angles at 750 and 825 MeV/c, and again showed a sharp peak at 900 MeV/c. Rapid changes in polarization were also observed for π^+p scattering in the forward direction from 900 MeV/c to 1150 MeV/c, when the peak in the backward hemisphere was replaced with a peak in the forward direction, finally at 1580 MeV/c the polarization appeared to be washed out. G.G.

N66-32738*# European Organization for Nuclear Research, Geneva (Switzerland).
PION INTERACTIONS WITH NUCLEI
T. E. O. Ericson *In* Coll. of William and Mary Intermediate Energy Phys., Vol. I Feb. 1966 187–205 p refs (See N66-32726 19-24) CFSTI: HC $5.65/MF $2.50

Low energy elastic pion interactions with nuclei were studied by applying the μ capture theory to radiative π capture with trivial kinematical changes. Calculations on total radiative

absorption rates in the closure approximation were corrected for phase space factors and applied to a Fermi gas after suitable modification to handle absorption in the 2p and 3d orbits. Predicted relative yields were compared to experimental branching ratios of radiative capture in ^{6}Li and ^{7}Li 1s orbits, C 1s and 2p orbits, and S and Cu 2p and 3d orbits. These theoretical descriptions agreed well with the experimental results. G.G.

N66-32739*# Rochester Univ., N. Y. Dept. of Physics and Astronomy.

TWO-NUCLEON EMISSION FOLLOWING ABSORPTION OF STOPPED NEGATIVE PIONS

M. E. Nordberg, Jr., K. F. Kinsey, and R. L. Burman *In* Coll. of William and Mary Intermediate Energy Phys., Vol. I Feb. 1966 p 207–222 refs Supported by AEC (See N66-32726 19-24) CFSTI: HC $5.65/MF $2.50

A beam of negative pions was brought to rest in a variety of light element targets ranging from Li^{6} to Al^{27}. The angular distributions of neutron–proton and neutron–neutron pairs emitted in the subsequent pion capture process were measured. The protons were detected in a scintillation counter telescope and the neutrons were detected in a plastic scintillation counter with an anti-coincidence guard counter. The threshold requirements discriminated against low-energy evaporation nucleons. The angular distributions peak strongly at 180°. Thsese distributions and the comparison of n–n to p–n rates are discussed and compared with other similar measurements and theoretical analysis. Author

N66-32740*# Liverpool Univ. (England).

PION CAPTURE AND NUCLEAR STRUCTURE

H. Davis, H. Muirhead, and J. N. Woulds *In* Coll. of William and Mary Intermediate Energy Phys., Vol. I Feb. 1966 p 223–240 (See N66-32726 19-24) CFSTI: HC $5.65/MF $2.50

Neutron pairs in the nuclei of Li^{6} and Li^{7}, exposed to a beam of negative pions, were measured for their total kinetic energy and angular distribution by scintillating counters with anti-coincidence guards. A sodium iodide crystal was used for separate measurements of the gamma emission that followed the pion capture. The distribution of total neutron momentum from capture on Li^{6} showed a solid curve when a model of an alpha particle cluster and a deuteron in a relative s state were used for evaluation calculations. The momentum distribution curve for pion capture on Li^{7} dipped near to zero momentum. Gamma spectra following the negative pion capture in nuclei showed fairly narrow peaks; this indicated that a simple capture of a negative pion on a nuclear proton produced a free neutron and a gamma ray. G.G.

N66-32741*# Rochester Univ., N. Y. Dept. of Physics and Astronomy.

THEORY OF PION ABSORPTION ON LIGHT NUCLEI

D. Koltun and A. Reitan *In* Coll. of William and Mary Intermediate Energy Phys., Vol. I Feb. 1966 p 241–252 refs (See N66-32726 19-24) CFSTI: HC $5.65/MF $2.50

An impulse approximation relating the interaction of two recoiling nucleons with a pion was used to analyze absorption of a pion by a nucleus. Additional interactions with scattering pions in s-waves were also applied to a variety of deuteron wave functions and final state wave functions as generated from nucleon–nucleon potentials. Results for the threshold cross section $\sigma(p + p \rightarrow \pi^{+} + d)$ agreed with experimental values and showed that both the rescattering (K_3, K_4, K_5, K_8) and the deuteron D-state (K_2, K_4, K_8) contributions are essential. Extension of this method to negative pion absorption for the case of O^{16} gave the ratio of n–n pairs to n–p pairs emitted as 3; however, rescattering changed that result to about 5. G.G.

N66-32742*# Virginia Univ., Charlottesville.

RADIATIVE PION ABSORPTION IN COMPLEX NUCLEI

D. K. Anderson and J. M. Eisenberg *In* Coll. of William and Mary Intermediate Energy Phys., Vol. I Feb. 1966 p 253–258 refs (See N66-32726 19-24) CFSTI: HC $5.65/MF $2.50 CSCL 20H

Radiative pion absorption calculations for O^{16} were performed by using the pseudoscalar interaction to obtain the transiton operator. In the presence of an electromagnetic field, this coupling mode was modified to an interaction where only negative pions are involved with a strong s-wave photoproduction of charged pions. Multipole expansion of the electromagnetic field to classify transitions according to the type of photon emitted showed that the El transition was small in closed shell nuclei since the transition operator vanished in the long wave length limit and the only contributions came from retardation effects. Use of the particle-hole formalism and O^{16} wave functions on the spin-isospin modes of the nuclear excitations showed that their greatest contributions to radioactive pion absorption were in the 20 to 25 MeV energy range. G.G.

N66-32743*# Virginia Univ., Charlottesville.

π^{-} ABSORPTION BY UNCORRELATED NUCLEONS IN O^{16}

Jean Le Tourneux *In* Coll. of William and Mary Intermediate Energy Phys., Vol. I Feb. 1966 p 259–267 refs Supported in part by AEC (See N66-32726 19-24) CFSTI: HC $5.65/MF $2.50

A study is made of the absorption from rest of π^{-} mesons by uncorrelated nucleons in O^{16}. The absorption probability is calculated for pions in the 1s and 2p orbits. The non-relativistic pion–nucleon interaction contains two terms, one of them involving the momentum of the nucleon, the other the momentum of the pion. The neglect of the latter is shown to be an unjustified procedure in the study of the absorption process. From the results of the present calculation, the absorption of a 2p pion by uncorrelated nucleons appears to be highly hindered with respect to the absorption process by a correlated pair, as could be expected from convervation principles.

Author

N66-32744*# Princeton Univ., N. J.

DOUBLE CHARGE EXCHANGE

J. Solomon *In* Coll. of William and Mary Intermediate Energy Phys., Vol. I Feb. 1966 p 269–276 (See N66-32726 19-24) CFSTI: HC $5.65/MF $2.50

A search was conducted for a $\Delta T_z = -2$ isobaric analog state in complex nuclei produced through the double charge exchange scattering of π^{+} mesons of V^{51}, Zr^{90}, and Li targets exposed to a pion beam. Scattered negative pions were detected with scintillation counters and a wire spark chamber was used to measure the momentum of the π^{-}. Measurements for V^{51} were plotted as numbers of events per 10 MeV/c bins versus the momentum of detected negative pions; but integrated cross section of less than 1 μb/sr were observed in the bins at both 7.5° and 15°. Zirconium scattering data also did not show any sign of the analog state at either temperature. Data on the broad lithium momentum spectrum indicated multiple-body first states rather than 2 body final states. G.G.

N66-32745*# European Organization for Nuclear Research, Geneva (Switzerland).

THE PRODUCTION OF CHARGED PIONS BY 600 MeV PROTONS ON VARIOUS NUCLEI

E. Heer, M. Martin (Geneva Univ.), E. G. Michaelis, P. Skarek, W. Hirt (Federal Polytech., Zurich), et al *In* Coll. of William and Mary Intermediate Energy Phys., Vol. I Feb. 1966 p 277–296 refs (See N66-32726 19-24) CFSTI: HC $5.65/MF $2.50

Charged pion production cross-sections in the forward direction were measured on CH_2, CD_2, Be, C, Al, Cu, Ag, and Pb targets exposed to 600 MeV proton energies from a synchrocyclotron. The extracted proton beam was focused by quadrupoles and directed by magnetic sources. A gas counter was used to identify electrons and a range counter to detect a fraction of the muons. Results of cross section measurements on elements from Be to Pb and at production angles of 0.8 and 21.5° are presented in tables. The hydrogen spectrum showed the characteristic deuteron peak; its pion at the cross section agreed well with earlier data, and was compatible with the nominal energy of 600 MeV at both angles. The carbon cross-sections for negative pions fell between 450 MeV and 725 MeV; positive carbon pion cross section values were lower than found in earlier studies. G.G.

N66-32746*# Stanford Univ., Calif.
MUON CAPTURE AND NUCLEAR STRUCTURE
J. D. Walecka *In* Coll. of William and Mary Intermediate Energy Phys., Vol. I Feb. 1966 p 297–326 refs (See N66-32726 19-24) CFSTI: HC $5.65/MF $2.50

The basic elements of muon capture in nuclei are reviewed and the fundamental lifetime of the free muon against β-decay is analyzed as it cascades down into the 1s atomic orbit until it either decays or is captured by a proton. Results of muon capture in H, He^3, and C^{12} as well as some of the partial capture rates in O^{16} indicate that the coupling constants are fairly close to their UFI values. Predominate capture processes are attributed to the supermultiplet of giant resonances. G.G.

N66-32747*# Catholic Univ. of America, Washington, D. C. Dept. of Physics.
MUON CAPTURE AND NUCLEAR GIANT RESONANCES
H. Ueberall *In* Coll. of William and Mary Intermediate Energy Phys., Vol. I Feb. 1966 p 327–376 refs (See N66-32726 19-24) CFSTI: HC $5.65/MF $0.50

The interrelation of giant resonance excitations by muon capture with other electromagnetic and weak excitations is examined. It is shown that due to the isospin dependence and to the particular structure of the weak and electromagnetic matrix elements, a variety of different states may be excited in neighboring nuclei. An attempt is made to demonstrate the fact that muon capture together with photo and electro-excitation as well as neutrino absorption form a family of reactions by which the giant resonances may be excited. The discussion is simplified by the predominant use of the Goldhaber–Teller model of the giant dipole state and its spin wave generalization. A classification of the resonance states is presented, and various sum rules are discussed. S.P.

N66-32748*# Yale Univ., New Haven, Conn. Gibbs Lab.
RECENT EXPERIMENTS ON MUONIUM
V. W. Hughes, J. Amato, R. Mobley, J. Rothberg, and P. Thompson *In* Coll. of William and Mary Intermediate Energy Phys., Vol. I Feb. 1966 p 377–409 refs (See N66-32726 19-24) CFSTI: HC $5.65/MF $2.50

Discussions are presented on measurement of the hyperfine structure of muonium and muonium chemistry or the interaction of muonium with atoms and molecules. The hyperfine structure interval in the ground state is measured by observation of an induced transition at weak magnetic fields. An imagined experiment to measure the hyperfine structure interval of the muonic hydrogen atom is described. Two related methods of studying the direct interactions of muonium with various molecules are examined. Both methods involve stopping of polarized muons in argon gas to form muonium atoms and observation of the effects due to the admixture of small fractional amounts of various molecules as impurities. S.P

N66-32749*# College of William and Mary, Williamsburg, Va.
MUON CAPTURE RATES IN COMPLEX NUCLEI
R. E. Welsh, M. Eckhause, R. T. Siegel, and T. A. Filippas (Carnegie Inst. of Tech.) *In its* Intermediate Energy Phys., Vol. I Feb. 1966 p 411–418 refs (See N66-32726 19-24) CFSTI: HC $5.65/MF $2.50

Results of a series of experiments to measure negative muon disappearance rates in complex nuclei are summarized. The experimental arrangement of the exposed targets, the raw timing data, and the muon capture rates are illustrated. Capture rates obtained were fitted to the Primakoff formula and the Fermi gas model. The results of these statistical fits are tabulated. S.P.

N66-32750*# California Univ., Berkeley. Lawrence Radiation Center.
COMPARISON OF THE LIFETIMES OF POSITIVE AND NEGATIVE PIONS
David S. Avres, Richard D. Eandi, Arthur S. Greenberg, Robert W. Kenney, Richard J. Kurz et al *In* Coll. of William and Mary Intermediate Energy Phys., Vol. I Feb. 1966 p 419–425 (See N66-32726 19-24) CFSTI: HC $5.65/MF $2.50

A preliminary data analysis is presented for measurement of the total lifetimes of positive and negative pi mesons and the ratio of these lifetimes. The $\pi^{\pm}$ lifetimes are determined by measuring the attenuation due to decay as a function of distance of nearly identical beams of π^+ and π^-. Determination of the exponential attenuation of the beams is accomplished measuring the number of pions in the beam as a function of distance along the beam trajectory. Experimental values for π^+ and π^- lifetimes are tabulated. S.P.

N66-32751*# Rochester Univ., N. Y. Dept. of Physics and Astronomy.
A MEASUREMENT OF THE LIFETIME OF THE POSITIVE PION
K. F. Kinsey, L. Lobkowicz, and M. E. Nordberg, Jr. *In* Coll. of William and Mary Intermediate Energy Phys., Vol. I Feb. 1966 p 427–438 ref (See N66-32726 19-24) CFSTI: HC $5.65/MF $2.50

The decay of about 10^8 positive pions is measured experimentally by use of fast electronic techniques and low-energy pion beams. The counter array and electronic apparatus used in the experiment are illustrated. Several parameters were varied for different runs to test for systematic effects, and the data for each run was fit by a search program which found the values of the mean lifetime and the background which gave the lowest chi-squared. The best values corresponding to the lowest error for each run are displayed. The value chosen was 26.40×0.08 nsec., which takes into account the small dependence on the low cutoff. Within this range, the lifetime is constant over several mean lives. S.P

N66-32752*# Massachusetts Univ., Amherst.
OPTICAL MODELS FOR PION–NUCLEUS SCATTERING
M. M. Sternheim and E. Auerbach (MIT) *In* Coll. of William and Mary Intermediate Energy Phys., Vol. I Feb. 1966 p 439–446 refs (See N66-32726 19-24) CFSTI: HC $5.65/MF $2.50

The problem of calculating the elastic scattering of pions by nuclei is discussed in light of optical model calculations and preliminary results. Two related approaches are described. One involves starting with information about the pion–nucleon interaction and nuclear structure, and calculating the pion–nucleus scattering. The alternative method involves fitting the pion–nucleus data with a phenomenological model and trying to extract some new information from the model. S.P.

N66-32753*# Northwestern Univ., Evanston, Ill.
PHASE SHIFT ANALYSIS FOR ELASTIC $\pi^+ - He^4$ SCATTERING IN THE ENERGY INTERVAL 100–160 MeV/c
M. M. Block, I. Kenyon, J. Keren, D. Koetke, P. K. Malhotra et al *In* Coll. of William and Mary Intermediate Energy Phys., Vol. I Feb. 1966 p 447–454 (See N66-32726 19-24) CFSTI: HC $5.65/MF $2.50

The continuing study of nuclear–coulomb interference effects at high momentum transfer with the objective of measuring the π-meson form factor is reported. Experimental results are also presented for another aspect of the phase shift analysis program of π-He^4 elastic scattering, which involves studies of light hypernuclei using a 20" helium bubble chamber. The differential elastic cross-sections are shown for events below the median momentum of the beam (141 Mev/c). S.F.

N66-32754*# Northwestern Univ., Evanston, Ill.
INELASTIC $\pi^+ - He^4$ REACTIONS IN THE MOMENTUM RANGE 100–160 MeV/c
M. M. Block, I. Kenyon, J. Keren, D. Koetke, P. K. Malhotra et al *In* Coll. of William and Mary Intermediate Energy Phys., Vol. I Feb. 1966 p 455–459 (See N66-32726 19-24) CFSTI: HC $5.65/MF $2.50

Inelastic reactions occurring when π^+ passes through liquid helium in a bubble chamber are discussed. The question of how inelastic events are found and separated from elastic ones is considered. Preliminary analysis of the absorption events showed that in over 2/3 of the cases there were two energetic KE > 20 MeV protons emitted. S.P.

N66-32755# International Centre for Theoretical Physics, Trieste (Italy).
THE USE OF DISPERSION METHODS IN THE STUDY OF SYMMETRIES
J. Fubini, G. Furlan, and C. Rossetti 4 Jun. 1965 19 p refs Sponsored by AFOSR
(IC/65/58)

Studies were made on problems in the group theoretical approach; consideration was given to estimating the corrections to group theoretical formulas due to symmetry-breaking terms in the Hamiltonian and to finding rules for translating group theoretical formulas into the language of experimental data for the case of the dynamical groups. The methods of quantum field theory and dispersion theory are used. Matrix elements and predictions for magnetic moments and form factors for SU(3) symmetry in the first order of symmetry breaking are obtained using commutation operators and completeness; sum rules are obtained by further assumptions. A method is developed for the evaluation of the commutator matrix elements, which preserves covariance at each order of approximation, using the causality condition in the dispersion-relations approach. The generalization of this method to dynamical groups, involving space–time quantum numbers like spin and parity, is discussed. NSA

N66-32766*# College of William and Mary, Williamsburg, Va. Dept. of Physics
INTERMEDIATE ENERGY PHYSICS, VOLUME II
Feb. 1966 375 p refs Proc. of a Conf. held at Williamsburg, Va., 10–12 Feb. 1966
(Grant NsG-567)
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17. NUCLEAR STRUCTURE MEASUREMENTS WITH THE BROOKHAVEN COSMOTRON J. L. Friedes, H. Palevsky, R. J. Sutter, G. W. Bennett (Brookhaven Natl. Lab.), R. L. Stearns (Vassar Coll.) et al D. M. Corley, N. S. Wall (Md. Univ.), G. C. Phillips, and W. D. Simpson (Rice Univ.) p 749–758 (See N66-32783 19-24)

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N66-32767*# Yale Univ., New Haven, Conn.
NUCLEON-NUCLEON SCATTERING
G. Breit *In* Coll. of William and Mary Intermediate Energy Phys., Vol. II Feb. 1966 p 471–493 refs Supported by AEC and AROD (See N66-32766 19-24) CFSTI: HC $4.25/MF $2.00

Phase-parameter analysis of nucleon–nucleon scattering at energies where meson production is negligible centered on the form of the scattering matrix and its observable parameters for cross sections, polarization, triple scattering, and polarization correlations. The use of one-pion exchange values of the phases for higher orbital momenta in the single energy analysis of p–p data, and in multiple energy analyses is demonstrated in several examples. G.G.

N66-32768*# Kentucky Southern Coll., Louisville.
PION–NUCLEON PHASE SHIFT ANALYSES
L. David Roper *In* Coll. of William and Mary Intermediate Energy Phys., Vol. II Feb. 1966 p 495–515 refs (See N66-32766 19-24) CFSTI: HC $4.25/MF $2.00

Experimental information about pion–nucleon and pion–pion resonances was utilized to calculate the various pion–nucleon phase shifts by means of the partial-wave dispersion relations with nucleon exchange. Single energy analyses obtained phase shifts at each individual energy, and energy-dependent analyses used energy parametrization methods for the phase shifts. The biggest disagreement among the different solutions was the energy dependence of the P_{11} phase shift; a P_{11} resonance did not fit into the SU_6 scheme of particle classification, whereas good fits for the S_{11}, S_{31}, and D_{15} resonances were obtained. G.G.

N66-32769 California Univ., Livermore. Lawrence Radiation Lab.
NON-DYNAMICAL STRUCTURE OF PARTICLE REACTIONS
Michael J. Moravcsik *In* Coll. of William and Mary Intermediate Energy Phys., Vol. II Feb. 1966 p 517–543 refs (See N66-32766 19-24) CFSTI: HC $4.25/MF $2.00

The advantages of the phenomenological description of reactions in terms of their invariant amplitudes or form factors are discussed, with emphasis focused on the properties of these form factors and the relationship between the physical observables which they determine. The topic is treated in terms of the M-matrix of a reaction; this matrix depends on the momenta and spins occurring in the reaction. It is a rank zero tensor in ordinary three- or four-dimensional space, and is a matrix in the combined spin spaces of the particles participating in the reaction. An example is given. The notion of an irreducible constituent reaction is introduced to show that more complicated reactions, involving more particles of non-zero spin, can be analyzed in terms of simple reactions. It is pointed out that for reactions which are composites of more than two irreducible constituents, the observables in a composite of three irreducible constituents have four classes, the observables in a composite of four have eight classes, etc. It is also shown that the observables can be subdivided into subclasses so that all observables in a given subclass depend on the products in one products set only. M.G.J.

N66-32770*# National Inst. for Research in Nuclear Science, Harwell (England). Rutherford High Energy Lab.
PHOTOPRODUCTION OF N* RESONANCES IN THE QUARK MODEL
R. G. Moorhouse *In* Coll. of William and Mary Intermediate Energy Phys., Vol. II Feb. 1966 p 545–549 refs (See N66-32766 19-24) CFSTI: HC $4.25/MF $2.00

The quark model for elementary particles is used in a discussion of s_{11}, d_{13}, s_{11}, and d_{15} resonances. An illustration of the quark model multiplets in a Dalitz diagram shows two T=1/2 states in the octet state. Also there are two s_{11} states, which appear to be filled, a d_{15} state which also appears to be filled, and two d_{13} states, having only one resonance. It is stated that this resonance could have been missed if it were very inelastic. The electromagnetic transitions $\gamma + N \rightarrow N^*$, $2S_{1/2}$ ^4P_J, when the N^* are the ^4P states of the quark model which includes the d_{15} state, are also discussed. The discussion concluded that in the quark model, the lowest s_{11} and the d_{13} resonance can be ascribed to the ^2P quartet, and in the ^4P quartet, s_{11}, d_{13}, and d_{15} resonances are not photo-produced. H.S.W.

N66-32771*# Vanderbilt Univ., Nashville, Tenn.
A COMPARISON OF RESONANCE FORMULAS FOR THE (1236 MeV, 3/2) PION NUCLEON RESONANCE
S. R. Deans and W. C. Holladay *In* Coll. of William and Mary Intermediate Energy Phys., Vol. II Feb. 1966 p 551–567 refs Supported in part by NSF (See N66-32766 19-24) CFSTI: HC $4.25/MF $2.00

To obtain information on the energy dependence of relativistic particle resonances, a comparison among six commonly used expressions for the total cross-section in the reaction $\pi^+ + p \rightarrow \pi^+ + p$ has been made in the energy region between 38 and 307 MeV (pion lab kinetic energy). The parameters in these expressions were systematically varied until the best fit (minimum χ^2) to fifty points was achieved for each formula. It was found that a significant statistical difference exists among some of the formulas used. Author

N66-32772*# California Univ., Los Angeles.
n–n S-WAVE SCATTERING LENGTH FROM THE NEUTRON SPECTRA OF THE REACTION $\pi^- + D \rightarrow 2n + \gamma$
R. M. Salter, Jr., M. Zeller, R. P. Haddock, J. B. Czirr (California Univ., Livermore), and D. R. Nygren (Washington Univ., Seattle) *In* Coll. of William and Mary Intermediate Energy Phys., Vol. II Feb. 1966 p 569–594 refs Sponsored by AEC and NSF (See N66-32766 19-24) CFSTI: HC $4.25/MF $2.00

A determination was made of the neutron–neutron S-wave scattering length giving $A_{nn} = -16.47 + 1.27F$. Comparison with measured values of the proton–proton and neutron–proton scattering lengths indicates charge symmetry of nuclear forces but not charge independence. The neutron time-of-flight and angle spectra from the bombardment of liquid deuterium with a negative pi meson yielding 2 neutrons as a gamma ray, were recorded. The P-wave contribution was minimized by restricting neutron–neutron relative moments to their center-of-mass system to $q < 50$ MeV/C. The analysis of the data was extended to include an independent determination of the neutron–neutron scattering length using the neutron angle spectra. C.L.W.

N66-32773*# United Kingdom Atomic Energy Authority, Harwell (England).
MEASUREMENTS OF THE DIFFERENTIAL CROSS-SECTION AND POLARIZATION IN PROTON–PROTON SCATTERING AT ABOUT 143 MeV
O. N. Jarvis, G. F. Cox, G. H. Eaton, B. Rose, and C. P. Van Zyl *In* Coll. of William and Mary Intermediate Energy Phys., Vol. II Feb. 1966 p 595–601 refs (See N66-32766 19-24) CFSTI: HC $4.25/MF $2.00

Cross-section measurements and polarization data are presented to replace outdated proton–proton scattering measurements. The differential cross-section measurements were made by two methods, which were independent except in relation to the calibration of the beam monitor. In the first method, a polythene target was used and scattered and recoil protons were recorded in coincidence. The second technique required the use of a liquid hydrogen target. The two sets of cross-section data were in agreement. S.P.

N66-32774*# United Kingdom Atomic Energy Authority, Harwell (England).
EXPERIMENTAL ASPECTS OF NUCLEON–NUCLEON SCATTERING AND POLARIZATION BELOW 1 BeV
B. Rose *In* Coll. of William and Mary Intermediate Energy Phys., Vol. II Feb. 1966 p 603–647 refs (See N66-32766 19-24) CFSTI: HC $4.25/MF $2.00

The present state of nucleon–nucleon data is reviewed. There has been a resurgence of interest in the problem at 300–700 MeV, partly stimulated by the availability of polarized targets. Some of the new data is clearing away old discrepancies and some revealing new ones. The precision of existing data is rarely as high as claimed, and much greater precision will be needed if unique energy independent analyses are to be carried out at the higher energies. Twice as many experimental papers are published on the p–p as on the n–p system. It is proposed that more attention be devoted to the neutron proton system with neutron beams, in preference to quasi-free experiments using the deuteron as a neutron target. The problems of doing so are discussed. Recent results on nuclear bremsstrahlungen are briefly mentioned. Author

N66-32775*# Northeastern Univ., Boston, Mass.
p–p BREMSSTRAHLUNG AT 160 MeV
B. Gottschalk, W. J. Shlaer, and K. H. Wang (Harvard Univ.) *In* Coll. of William and Mary Intermediate Energy Phys., Vol. II Feb. 1966 p 649–665 (See N66-32766 19-24) CFSTI: HC $4.25/MF $2.00

The geometry and technique used to measure pion–pion bremsstrahlung at 160 MeV are discussed. The measuring principle is defined as reliance on the kinematic relations between the two protons. A simplified diagram of the experiment which uses a liquid hydrogen target, is given. Two counters determine the energy of the protons; they are set at angles so that elastic coincidences are excluded. The counters form a trigger, which causes their pulses, and also the pulse from the gamma detector (a Cerenkov counter) to be analyzed and recorded. It is emphasized that the gamma counter is not in the trigger requirement. Details are given on the apparatus used in the experiment. Illustrations are given of the observed scatter plots, which were found to fit the kinematic expectations very well. The gamma ray angular distribution is also plotted, and cross sections integrated over all gamma-ray angles at various scattering angles are depicted. Graphs illustrate Cerenkov counter output versus gamma ray angle inferred from proton data. L.E.W.

N66-32776*# Michigan State Univ., East Lansing.
p–p BREMSSTRAHLUNG CALCULATIONS
P. Signell and D. Marker (Hope Coll.) *In* Coll. of William and Mary Intermediate Energy Phys., Vol. II Feb. 1966 p 667–676 (See N66-32766 19-24) CFSTI: HC $4.25/MF $2.00

Various potential models for predicting the PPγ are compared and discussed. Discrepancies are pointed out, and graphs are presented for potential–radius and phase shift calculations. It is suggested that the following list of potential models is sufficiently exhaustive: (1) hard core+strong attraction, (2) long-range finite core+weak attraction, (3) weak, momentum dependent, and (4) non-local, separable. N.E.N.

N66-32777*# Rochester Univ., N. Y. Dept. of Physics and Astronomy.
NUCLEON–NUCLEON BREMSSTRAHLUNG AT 200 MeV
K. W. Rothe, P. F. M. Koehler, and E. H. Thorndike *In* Coll. of William and Mary Intermediate Energy Phys., Vol. II Feb. 1966 p 677–689 refs (See N66-32766 19-24) CFSTI: HC $4.25/MF $2.00

The off mass shell nucleon–nucleon scattering behavior was examined at energies near 200 MeV. The experimental setup depicts an incident beam of 204 MeV protons striking a 3" target, and the resulting gamma-ray detected in coincidence with two protons; this coincidence triggers the spark chambers. Kinematic data on eight of the final state variables is obtained. The gamma-ray energy spectrum illustrated indicates spectrum consistency up to the highest allowed gamma energy. Data show the proton–proton reaction cross section integrated over the gamma energy. Angular distribution and number of events are graphed, and measurements of several bremsstrahlung cross sections are reported. R.L.I.

N66-32778*# Rochester Univ., N. Y. Dept. of Physics and Astronomy.
NEUTRON–PROTON INTERACTIONS AT 205 MeV
E. H. Thorndike, N. W. Reay, D. Spalding, and A. R. Thomas *In* Coll. of William and Mary Intermediate Energy Phys., Vol. II Feb. 1966 p 691–702 refs (See N66-32766 19-24) CFSTI: HC $4.25/MF $2.00

Neutron–proton interactions resulting from the bombardment of deuterons with 205 MeV polarized protons were studied, high energy neutrons recoiling into forward angles were observed, and the parameters polarization and triple scattering (P and R_t) were measured. Incident proton beam polarization was manipulated with a solenoid to lie in a horizontal plane and normal to the beam direction; and polarization sign was reversed by changing the current direction through the solenoid. Measurements of P were made at neutron laboratory angles between 10 and 30°, and of R_t between 0 and 20°. An impulse approximation, which includes the s-wave final state interaction of the two protons, was calculated to relate the reaction to neutron–proton scattering. In the predicted neutron spectrum for 5° laboratory singlet scattering dominates and is sharply peaked. At 20°, the broader peak of the free n–p scattering is dominant, and energy independent solutions are graphed and compared with theoretical fits. M.W.R.

N66-32779*# Northeastern Univ., Boston, Mass.
QUASI-FREE PROTON SCATTERING AT 160 MeV
B. Gottschalk, W. J. Schlaer, K. Strauch, and K. H. Wang (Harvard Univ.) *In* Coll. of William and Mary Intermediate Energy Phys., Vol. II Feb. 1966 p 703–718 (See N66-32766 19-24) CFSTI: HC $4.25/MF $2.00

Measurements were designed to test how closely the (p,2p) reaction approximates a knock-out reaction. The formalism for knock-out model expressions in plane-wave approximation is detailed; and the cross section which follows equals a product of a kinematic function, an effective cross section for the primary p–p interaction, and the probability of finding a target proton with the appropriate initial momentum to yield an event in the phase-space incremental volume being studied. Nuclear momentum distributions can be inferred from these measurements; and an attempt is made to determine how well the cross section depends only on P(q), with q defined as the recoil momentum of the residual nucleus after the interaction which, in the impulse approximation, equals the negative of the target proton momentum before the interaction. Scatter plots for carbon at 160 MeV incident energy are graphed, as are the binding energy spectrum of carbon, and cross sections of carbon p and s state events versus scattering angle. A comparison is made of the distorted momentum distributions measured at 160 and 460 MeV for carbon, and some preliminary results are graphed for oxygen 16. M.W.R.

N66-32780*# Maryland Univ., College Park.
A SHELL-MODEL CALCULATION OF THE QUASI ELASTIC SCATTERING OF PROTONS FROM COMPLEX NUCLEI
N. S. Wall *In* Coll. of William and Mary Intermediate Energy Phys., Vol. II Feb. 1966 p 719–729 (See N66-32766 19-24) CFSTI: HC $4.25/MF $2.00

A plane wave impulse approximation has been used to derive the momentum distribution for the nucleons in the nucleus from an extreme shell model point of view. Single particle states are derived in the shell model potential and Fourier transformed to put them into an equation for the cross section. It is assumed that the momentum distribution for the

1s state is not too different from that given by the local non-energy dependent potential. In the evaluation of K_{min}, an estimate of 75 MeV is made for the binding energy. Calcium 40 quasi-electric spectra are graphed, as is energy at the peak as a function of the scattering angle. Detailed spectrum are shown for 20, 30 and 50°; and for the last spectrum it is shown that at energies corresponding to about 20 MeV residual energy, there is a cross section two or three times greater than that predicted. Absorption is not taken into account, since it should distort the spectrum. M.W.R.

N66-32781*# Battersea Coll. of Technology, London (England).

CHANGES IN RADII BETWEEN NEIGHBOURING NUCLIDES

L. R. B. Elton and A. Swift *In* Coll. of William and Mary Intermediate Energy Phys., Vol. II Feb. 1966 p 731-741 refs (See N66-32766 19-24) CFSTI: HC $4.25/MF $2.00

Experimental values of $R A^{-1/3}$, as obtained from μ-mesic atomc, are graphically depicted. This evidence confirms the law governing the radii of nuclei along the line of maximum stability (in which the constants are fitted to electron scattering data). Tables of Saxon–Woods well parameters and energy levels for several nuclides are also given. A curve depicting the isotope difference of electron scattering from Ca^{40} and Ca^{44} at 250 MeV based on these parameters; and a curve depicting the proton distributions for Ca^{40} and Ca^{44} which yield a fit to the electron scattering curve just mentioned, are given. Several factors relating to the governing law (nuclear Coulomb energy, nuclear compressibility), are defined. Measurement of the X-ray energies of nuclides, for which shell effects are unimportant, due to the $2p_{3}$–$1s_{1/2}$ transition in μ-mesic atoms yielded values of the radius both for different isotopes of the same element and/or elements with neighboring atomic numbers. L.S.

N66-32782*# Franklin Inst., Swarthmore, Pa. Bartol Research Foundation.

COHERENT NEUTRON PROTON-HOLE EXCITATIONS IN NUCLEI

S. Fajlieros, T. A. Hughes, and B. Goulard (Universite Lavae) *In* Coll. of William and Mary Intermediate Energy Phys., Vol. II Feb. 1966 p 743-748 refs (See N66-32766 19-24) CFSTI: HC $4.25/MF $2.00

(Contract Nonr-3777(00))

The possible presence of coherent neutron proton-hole pair (n–p) excitations in heavy nuclei are examined. Results of calculations indicate that coherent n–p excitation can be expected to exist in these nuclei. Both states can still be described by definite values of the isotopic spin quantum number, but they are no longer members of the same isospin multiplet. The situation is illustrated in a particle-hole state diagram for the case of Zr^{90}. Detailed calculations of the odd parity states in Y^{90} were performed using this picture. A number of energy levels of Y^{90} and Zr^{90} were found. Also plotted is the relative value of the reduced El transition rate in arbitrary units normalized to 1 as a function of the number of excess neutrons in a considered nucleus. This graph gives a qualitative idea of the distribution of the dipole strength in the nucleus. L.S.

N66-32783*# Brookhaven National Lab., Upton, N. Y.

NUCLEAR STRUCTURE MEASUREMENTS WITH THE BROOKHAVEN COSMOTRON

J. L. Friedes, H. Palevsky, R. J. Sutter, G. W. Bennett, R. L. Stearns (Vassar Coll.) et al *In* Coll. of William and Mary Intermediate Energy Phys., Vol. II Feb. 1966 p 749-756 Supported by AEC (See N66-32766 19-24) CFSTI: HC $4.25/MF $2.00

The Brookhaven cosmotron was studied to determine whether its energy resolution and energy stability were adequate for nuclear structure measurements. Internal beam intensity was found to be about 5×10^{11} protons per pulse; the time average current, with a 2.5 sec rep. rate, is 8 nA and the beam spill length is 100 to 200 milliseconds; and the energy range can be varied from 500 MeV to 3 BeV. Preliminary measurements had indicated the beam energy spread to be less than 3 MeV and the long-term stability to be better than 1.5 MeV. As a result of these findings, a large spectrometer system was built to permit elastic and inelastic scattering and (p,2p) measurements at 1 BeV incident energy. The experimental set-up is detailed, and some preliminary data are reported. A momentum spectrum was obtained by putting the 1 BeV beam from the cosmotron right through the spectrometer. The scattering of 1 BeV protons from water at 9.3° shows the ground state and first excited state of oxygen, and a rather large peak is attributed to p,p elastic scattering from the hydrogen in the water. Similar scattering from carbon is illustrated. M.W.R.

N66-32784*# Oxford Univ. (England).

SUMMARY OF WILLIAMSBURG CONFERENCE ON INTERMEDIATE ENERGY PHYSICS

D. H. Wilkinson *In* Coll. of William and Mary Intermediate Energy Phys., Vol. II Feb. 1966 p 757-773 (See N66-32766 19-24) CFSTI: HC $4.25/MF $2.00

A general summary is presented of data on nuclear structure measurements and newly-developed methods reported at the Williamsburg conference on intermediate energy physics. It is noted that, to a large degree, such research began simply because elementary particle beams were available from big accelerators which had begun to outlive their usefulness for elementary particle work. At the present time, however, new particle beams are being made at existing accelerators and consideration is being given to the construction of bigger accelerators intended mainly for nuclear structure measurements. Muonic X-ray measurements are discussed, along with the precision required for two and three parameter studies. Reports on isotope shift in light and heavy metal elements, quadrupole moment and splitting, and distributed dipole moment are reviewed in relation to muonic X-rays. Muon capture is mentioned; and among the pion phenomena discussed are radiative pion capture, energy shifts of high pionic levels, and pion adsorption. It is stressed that while the summary is far too short and selective, it does point out the potential power of many new approaches to the nucleus. M.W.R.

N66-32785*# Carnegie Inst. of Tech., Pittsburgh, Pa.

SUMMARY OF CONFERENCE

L. Wolfenstein *In* Coll. of William and Mary Intermediate Energy Phys., Vol. II Feb. 1966 p 775-792 (See N66-32766 19-24) CFSTI: HC $4.25/MF $2.00

A summary of data relating to experiments and present-day knowledge on the interaction of elementary particles deals with information presented at the conference as well as from other sources. Weak interactions and mu decay are discussed, and the latter described as the prototype of all weak reactions because it is a purely leptonic process. Semileptonic interactions, such as those responsible for the beta decay of the neutron or for mu capture, are discussed. The mu-electron universality for the axial vector current, the conserved vector current theory, and other aspects of muon capture are mentioned. Electromagnetic interactions are discussed as a probe of the structure of particles, and several experiments are reported. Strong interactions are treated from the point-of-view of symmetries; including time reversal invariance, charge independence, and symmetry breaking. Phase shift analysis of the pion–nucleon and nucleon–nucleon scattering; and the large numbers of newly discovered resonances at 1400, 150, and 1680 MeV are mentioned. M.W.R.

N66-32801 Michigan Univ., Ann Arbor.
CROSS-OVER SIGNALS IN ATOMIC HYDROGEN
Lewis Craig Himmell (Ph.D. Thesis) 1965 119 p refs
(Contract AT(11-1)-1112)
(TID-22044)

The angular distribution function for resonant fluorescent scattering of Lyman alpha photons on atomic hydrogen when there are degeneracies in the excited states is examined. The calculations included all effects in the hamiltonian that were larger than 0.1 Mc/sec. The theory was then applied to atomic hydrogen assuming an infinitely massive proton. The Dirac equation, with some radiative corrections added phenomenologically, was used to determine the energy levels of the system. The level crossings were obtained by means of an external axially symmetric magnetic field. Finally, the general theory of resonance fluorescence in hydrogen is considered. NSA

N66-32807# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
SOME RESULTS OF A STUDY OF LITHIUM-ION DRIFT IN SILICON p-TYPE MONOCRYSTALS [NEKOTORYE REZUL'TATY ISSLEDOVANIYA DREIFA IONOV LITIYA V KREMNIEVYKH MONOKRISTALLAKH P-TIPA]
A. S. Antonov and L. G. Yuskeselieva 1966 14 p refs In RUSSIAN
(JINR-P-2598)

The results are reported of experimental study of p-i-n structure in the p-type silicon which is formed by lithium-ion drift in the electric field of the p-n junction. Changes (during the drift) in the boundary location between the n-i and p-regions as well as in the width of the negative space charge in the p-n junction are studied. Some regularities in the lithium-ion drift are established. The results obtained are compared with the existing theory. Author (NSA)

N66-32810# Tokyo Univ. (Japan). Inst. for Nuclear Study.
NUMERICAL DIFFERENTIAL CROSS SECTIONS OF SOME REACTIONS ON C^{13} INDUCED BY 54.9 MeV PROTONS
H. Taketani, H. Yamaguchi, J. Muto, J. Kokame, N. Inoue et al 29 Sep. 1965 22 p
(INSJ-89)

Numerical differential cross sections of (p,d) and (p,t) reactions on ^{13}C are presented. The target used is a self-supporting film of thickness 3.7 mg/cm^2 (^{13}C, 56%; ^{12}C, 44%). The energy of the incident protons is 54.9 ±0.4 MeV. Momentum analysis of the reaction products is performed with a magnetic analyzer, operated with momentum resolution of about 0.3%. Nuclear photographic plates are used for the detection of the reaction products. In some cases, aluminum absorbers of various thicknesses are placed in front of the plates for the discrimination of various particles. In (p,d) reactions, seven prominent deuteron groups corresponding to the excitation energies of 0, 4.43, 7.66, 9.64, 12.71, 15.11 and 16.11 MeV in ^{12}C are observed. Angular distributions (some not complete) are obtained for these groups only. In (p,t) reactions, four prominent triton groups corresponding to the ground, first (1.99 MeV), second (4.38 MeV), and third (4.82 MeV) excited states in ^{11}C are observed. Angular distributions (some not complete) are obtained for these groups only. Absolute cross sections are obtained. Absolute uncertainties are believed to be less than 30%. Author (NSA)

N66-32811# Aerojet-General Nucleonics, San Ramon, Calif.
THE Be^9 (n, 2n) REACTION AND ITS INFLUENCE ON THE AGE AND FAST EFFECT IN BERYLLIUM AND BERYLLIUM OXIDE
Sterrett Theodore Perkins (Ph.D. Thesis—Calif. Univ., Berkeley) Oct. 1965 263 p refs
(Contract AT(04-3)-368)
(AN-1443; TID-22446) CFSTI: HC $6.00/MF $1.50

The age and fast effect in beryllium and beryllium oxide are calculated from a solution of the moments equations in the multigroup approximation. The group structure involves 66 groups from 14.9 MeV down to 1.12 eV. The analysis includes a complete evaluation of the cross sections, angular distributions, and decay modes for all neutron-induced reactions in beryllium and oxygen. The principal decay mode of the ^9Be (n, 2n) reaction appears to be through inelastic excitation of the 2.43-MeV level in ^8Be. This level decays by neutron emission mainly to the 2.90-MeV level in ^8Be, and also, to a much lesser extent, to the ground state of ^8Be. The next largest contribution to this reaction is through a multibody breakup to the ground state of ^8Be. Analytical expressions for the Legendre components of the multigroup transfer matrices are specified for neutron degradation by (n, 2n) reactions and elastic and inelastic scattering (both by level excitation and the evaporation model). The specification of the transfer matrices for the $A(n,n_1)A^*(n_2)(A-1)^*$ reaction and the $^9Be(n,n_1)^9Be^*$ ($\alpha_1{}^5He^*$ ($n_2)\alpha_2$ reaction are simplified by theorems describing time-successive nuclear reactions. These theorems give the Legendre components of the collision integral in the transport equation in terms of those of the individual processes in the chain. Other forms of the (n,2n) reaction for which transfer matrices are developed are the cluster model, the n-body phase space model, and the evaporation model. The transfer matrices and a group cross section generator are programmed for the IBM-7079/94 computer (the AGN-SIGMA code). Both the P_0 and P_1 transfer matrices are calculated for all reactions and the (n,2n) reaction is found to be highly anisotropic, particularly for the second neutron. However, neither the age nor the fast effect is strongly dependent upon this anisotropy nor the spectra of this reaction. The fast effect and age are calculated by the INFIRM (IBM-7090/94) computer code, and compared with experimental results. Author (NSA)

N66-32812# Aerojet-General Nucleonics, San Ramon, Calif.
USERS MANUAL FOR AGN-SIGMA: A CODE TO CALCULATE THE LEGENDRE COMPONENTS OF THE MULTIGROUP TRANSFER MATRICES AND THE GROUP CROSS SECTIONS
S. T. Perkins, D. W. Thompson, and P. J. Du Bois Oct. 1965 35 p
(Contract AT(04-3)-368)
(AN-1447; TID-22447) CFSTI: HC $2.00/MF $0.50

The AGN-SIGMA code is used to calculate the Legendre components of the multigroup transfer matrices through the fifth degree, for fast neutrons. Reactions considered are elastic scattering, inelastic scattering (level excitation and the evaporation model), and the (n,2n) reaction (five decay modes). The code is also used to calculate group-averaged cross sections, as well as to manipulate, e.g., add, multiply, etc., the output matrices. The neutron spectrum may be a combination of fission and 1/E or arbitrary input data. The calculation is limited to 100 groups and 50 groups downscatter. The program is written in FORTRAN II language for the IBM 7090/94 computer. Computer time for complex problems may vary from several minutes (scattering reactions) up to an hour (the n,2n reaction). Author (NSA)

N66-32813# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Groupe de Recherches sur la Fusion Controlee.
THEORETICAL PROFILES OF THE SPECTRAL LINES OF THE HYDROGEN ATOM [PROFILS THEORIQUES DES RAIES SPECTRALES DE L'ATOME D'HYDROGENE]
Hoe Nguyen Lab. de Rech. Phys., Sorbonne, Paris) Hans-Werner Drawin, and Louis Herman Dec. 1965 42 p refs In FRENCH
Sponsored by EURATOM
(CEA-R-2912; EUR-2630-f)

The line-broadening problem of the hydrogen lines was formulated in the quasistatic approximation as far as the ions are concerned, and in the classical path approximation as far as the broadening due to collisions with electrons is concerned. These electrons interfere in different numerical results only by the self-correlation function of the fluctuating electrical field strength created at each point in the plasma. The Lewis correction was applied, but using the whole velocity distribution function of the electrons. The formula which represents the usual impact profile, valid only for frequncies much smaller than the plasma frequency, was extended using another formula which will be valid up to the neighborhood of that spectral region where the quasistatic approximation begins to be valid also for the electrons. As an example, the line profile of Ly α is given by some graphs for $T = 10^4$°K and electron densities $N = 10^{17}$ cm^{-3} and $N = 10^{18}$ cm^{-3}. Author (NSA)

N66-32817# Comitato Nazionale per l'Energia Nucleare, Roma (Italy).
ELASTIC CROSS SECTIONS OF LOW-ENERGY ELECTRONS IN RARE GASES
G. L. Braglia, G. M. de'Munari, and G. Mambriani Dec. 1965 14 p refs
(RT-FI(65)-60)

Elastic total cross sections and momentum transfer cross sections of electrons in helium, neon, argon, krypton and xenon, are reported as functions of the electron energy from 10^{-3} eV up to first-excitation energy of each type of atom. The said cross sections were obtained from several data given in literature. The chosen cross sections are reported both in numerical and in graphical form. The numerical values, written with three figures, are given for convenience of anyone who has to perform numerical calculations. The graphs are drawn so as to give an indication of the accuracy of the numerical data. Author (NSA)

N66-32818# Illinois Univ., Urbana. Dept. of Physics.
[RESEARCH IN ELEMENTARY PARTICLE PHYSICS] Annual Progress Report, 1965
E. L. Goldwasser, A. Wattenberg, and G. M. Almy Apr. 1966 45 p refs
(Contract AT(11-1)-1195)
(COO-1195-56) CFSTI: HC $2.00/MF $0.50

Some investigation of resonance production in π^-–p, π^+–d, K^-–p, and p–p interactions at high energies, strange particle production in p–p interactions, π–N coupling photoproduction of mesons (π^-), and the decay of mesons (K^0_2) are summarized. Efforts in the development of counters, wire spark chambers, and data analysis systems are also outlined. NSA

N66-32819# Institute of Mathematical Science, Madras (India).
REPORT ON RECENT EXPERIMENTAL DATA, 1965
K. Venkatesan [1966] 176 p refs *Its* Rept.-40
(NP-15964)

The set of reports on Recent Experimental Data issued every month during the year 1965 are included. The production of the antideuteron is discussed. The continuing search for quarks is discussed. A crop of new resonances are reported and the work of the Maglic group who have suggested a new method for locating resonances quickly and have applied it to the boson spectrum up to 2.5 BeV is reported. NSA

N66-32823# Oak Ridge National Lab., Tenn.
AN INVESTIGATION OF (p,n) REACTION MECHANISM VIA ISOSPIN ANALOG RESONANCES
H. J. Kim and R. L. Robinson [1965] 13 p refs Presented at the Am. Phys. Soc. Conf. on Isobaric Spin, Tallahassee, Fla. (Contract W-7405-ENG-26)
(ORNL-P-2217; CONF-660306-5) CFSTI: HC $1.00/MF $0.50

An investigation was made of the excitation functions and angular distributions of neutron groups produced by the (p,n) reactions on ^{88}Sr and ^{89}Y in the energy region of well established $d_{5/2}$ isolated resonances. These resonances are due to the isobaric analogues of the $d_{5/2}$ neutron states of ^{89}Sr and ^{90}Y. The neutron groups feeding the ground state of ^{88}Y, ground state of ^{89}Zr, and 590 keV state of ^{89}Zr were detected by time-of-flight methods in conjunction with a pulsed proton beam accelerated by the ORNL 5.5 MeV Van de Graaft accelerator. NSA

N66-32824# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
STUDY OF CRYSTALLINE DEFECTS BY MEANS OF THE RESONANCE OF ADJACENT NUCLEI [ETUDE DES DEFAUTS CRISTALLINS AU MOYEN DE LA RESONANCE DES NOYAUX VOISINS]
Colette Minier-Cassayre Dec. 1965 28 p refs In FRENCH
(CEA-BIB-67)

The phenomena of nuclear resonance can give information on the structure of crystalline defects, on their mobilities and interactions. The effect of defects on dipolar resonance is reviewed, in particular, the modification of the Knight shift; the analysis of phenomena in ferromagnetic material and variations of relaxation time T_1. The effect of crystalline defects on the quadrupole interaction in a strong magnetic field and after in zero field was investigated. Author NAS

N66-32825# Virginia Polytechnic Inst., Blacksburg. Dept. of Physics.
NEUTRON PRODUCTION IN D_2O FROM DELAYED GAMMA RAYS PRODUCED IN THERMAL FISSION OF U^{235} Final Progress Report, Jun.–Dec. 1965
Ronald J. Onega [1966] 18 p refs
(Contract AT(40-1)-3409)
(TID-22889) CFSTI: HC $1.00/MF $0.50

The neutron production in D_2O from delayed gamma rays produced in the thermal fission of ^{235}U was investigated. A small sample of ^{235}U was placed in a small sphere of D_2O and irradiated for various times. The irradiation time is determined by a neutron chopper. Some preliminary results are given. NSA

N66-32835# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
GAMMA-RAY SPECTRUM FROM ^{141}Pm → ^{141}Nd DECAY [SPEKTR GAMMA-LUCHEI IZ RASPADA ^{141}Pm → ^{141}Nd]
R. Arl't, N. Bonch-Osmolovskaya, J. Vrzal, J. Liptak, and J. Urbanec 1966 7 p ref In RUSSIAN
(JINR-P-2618)

Results of gamma-spectrum measurements of ^{141}Pm are given. It is established that gamma-rays can be attributed to the ^{141}Pm decay, the absolute number of gamma-transitions per decay is determined, and the tentative decay scheme for ^{141}Nd is suggested. Author (NSA)

N66-32836# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
JANUARY: IBM 7094 PROGRAM FOR THE RESOLUTION OF CELL PROBLEMS IN PLANAR, SPHERICAL, AND CYLINDRICAL GEOMETRY USING THE DOUBLE P_n APPROXIMATION [JANIVER: PROGRAMME DE RESOLUTION SUR IBM 7094 DES PROBLEMES DE CELLULES EN GEOMETRIE PLANE, SPHERIQUE ET CYLINDRIQUE DANS L'APPROXIMATION DOUBLE P_n]

Albert Amouyal and Henri Tariel Feb. 1966 17 p refs In FRENCH
(CEA-R-2896)

A FORTRAN II program was written for resolving cell problems with one space variable and with one energy group, with isotopic sources in the double P_n approximation. The differential equations with limiting conditions were transformed into differential system with initial conditions which are integrated by a separate-step method. NSA

N66-32838# Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires.

ON THE SOLUTION OF A FEW PROBLEMS OF MULTIPLE SCATTERING BY MONTE CARLO METHOD [SUR AL SOLUTION DE QUELQUES PROBLEMES DE DIFFUSIONS MULTIPLES PAR LA METHODE DE MONTE-CARLO]

Jean-Claude Bluet Feb. 1966 55 p refs In FRENCH
(CEA-R-2971)

Three problems of multiple scattering arising from neutron cross section experiments, are reported. The common hypotheses are: elastic scattering is the only possible process, angular distributions are isotropic, and losses of particle energy are negligible in successive collisions. In the three cases practical results, corresponding to actual experiments are given. Moreover the results are shown in more general ways, using dimensionless variable such as the ratio of geometrical dimensions to neutron mean free path. The FORTRAN codes are given together with the corresponding flow charts, and lexicons of symbols. The three problems are as listed: (1) Measurement of sodium capture cross section. A sodium sample of given geometry is submitted to a neutron flux. Induced activity is then measured by means of a sodium iodide crystal. The distribution of active nuclei in the sample, and the counter efficiency are calculated by Monte Carlo method taking multiple scattering into account. (2) absolute measurement of a neutron flux using a glass scintillator. The scintillator is made of lithium-6 loaded glass, and was submitted to neutron flux perpendicular to its plane faces. If the glass thickness e is not negligible compared with scattering mean free path λ, the nean path e' of neutrons in the glass is different from the thickness. Monte Carlo calculations are made to compute this path and a relative correction to efficiency equal to $e'-e/e$. (3) Study of a neutron collimator. A neutron detector is placed at the bottom of a cylinder surrounded with water. A neutron source is placed on the cylinder axis, in front of the water shield. The number of neutron tracks going directly and indirectly through the water from the source to the detector are counted. Author (NSA)

N66-32853# Atomic Energy Centre, Dacca (Pakistan).

(n, CHARGED PARTICLES) EXPERIMENTS USING SEMICONDUCTOR DETECTOR

M. Aminul Haque Jan. 1966 13 p refs
(AECD/EP-9)

An introduction to the experimental approach to study neutron induced reactions using semiconductor detectors was presented. The emphasis was made mainly to explain the principle and characteristics of semiconductor detectors as used to detect the charged products in neutron induced reactions for the angular distribution studies. Author (NSA)

N66-32860# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

THE ORHEX CODE (DEP 053 S). RESOLUTION OF TWO-GROUP SCATTERING EQUATIONS IN HEXAGONAL GEOMETRY [CODE ORHEX (DEP 053 S). RESOLUTION DES EQUATIONS DE LA DIFFUSION A DEUX GROUPES DANS UNE GEOMETRIE HEXAGONALE]

Jean-Paul Bayard, Andre Guillou, Ginette Guillou, and Therese Lena Feb. 1966 60 p In FRENCH
(CEA-R-2977)

ORHEX is a code which was written for the IBM-7094 computer. It can solve two-group scattering equations (by calculating the neutron fluxes and the proper valve k_{eff}) for a two-dimensional hexagonal geometry. It is assumed that the cross section of the reactor under consideration can be represented by a juxtaposition of regular homogeneous hexagons; this set-up is particularly well adapted to graphite-type reactors. The equations are solved by alternating exterior iterations in the case of the proper value (acceleration using Tchebycheff's polynomial method) and internal iterations in the case of flux calculations (over-relaxation by blocks). Author (NSA)

N66-32862# International Centre for Theoretical Physics, Trieste (Italy).

CURRENT × CURRENT INTERACTION AND $|\Delta I| = 1/2$ RULE

Y. Hara 2 May 1966 11 p refs
(IC-66/44)

It is shown that the $|\Delta I| = 3/2$ amplitudes of hyperon decays are negligible in the limit of zero pion four momentum even if one assumes that the nonleptonic weak interaction is a product of the weak charged current and its hermitian conjugate. NSA

N66-32863# Hamburg Univ. (West Germany). Institut fuer Experimentalphysik.

CURRENT COMMUTATION RELATIONS IN THE FRAMEWORK OF GENERAL QUANTUM FIELD THEORY

B. Schroer and P. Stichel Feb. 1966 44 p refs Prepared in cooperation with Deut. Elektronen-Synchrotron
(DESY-66/6)

A rigorous formulation of Gell-Mann's equal time commutation relations is given in the framework of general quantum field theory. It is shown that sum rules of the Adler-Weisberger type can be derived without making any additional assumptions on the high-energy behavior of amplitudes. Two different methods of derivation are discussed, the first one is an improved version of the Fubini-Furlan method, the second one avoids the application of the Gauβ-Theorem and uses the Jost-Lehmann-Dyson-representation directly for the commutator of currents. In neither case does one get a dependence on the frame of reference. Author (NSA)

N66-32864# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.

COHERENT PRODUCTION OF π MESONS IN 3.85-GeV/cπ-COLLISIONS WITH PHOTOEMULSION NUCLEI [KOGERENTNOE OBRAZO VANIE π-MEZONOV V STOLKNOVENIYAKH π^--MEZONOV S IMPUL'SOM 3.85 GeV/c S YADRAMI FOTOEMUL'SII]

B. A. Shakhbazyan 1966 7 p refs In RUSSIAN
(JINR-P-2624)

It is shown that according to the existing selection criteria for the coherent $\pi \rightarrow 3\pi$ events, the upper limit of the cross section for this process on light emulsion nuclei is 0.5 mb. Author (NSA)

N66-32873# International Centre for Theoretical Physics, Trieste (Italy).

MASS FORMULAE AND U(6)× ANTI $\bar{U}$(6) MIXING

G. Cocho and R. White 15 Apr. 1966 8 p refs
(IC-66-35)

Particles have been previously considered as belonging to representations of $U(6) \otimes \bar{U}(6)$, where quarks transform according to U(6) and antiquarks according to $\bar{U}(6)$. The possibility is considered that the physical particles be given by mixtures of different levels of the $U(6) \otimes \bar{U}(6)$ tower but that the interactions be invariant under $U(6) \otimes \bar{U}(6)$. NSA

N66-32874# Paris Univ., Orsay (France).
COULOMB FORM FACTORS OF B^{10} AND B^{11}
T. Stovall, J. Goldemberg, and D. B. Isabelle Mar. 1966 31 p refs
(LAL-1154)

The electron scattering cross section of ^{10}B and ^{11}B was measured at incident energies of 198.5, 333, and 400 Mev for various scattering angles. The data were analysed so as to yield values of the mean squared charge radius and the nuclear quadrupole moment. Several nuclear models are considered. Author (NSA)

N66-32878# Oak Ridge National Lab., Tenn.
THE NATURE OF INTERACTION IN HEAVY ATOMIC NUCLEI
H. Euler [1965] 28 p refs Transl. into ENGLISH from Z. Phys. (Berlin), v. 105, 1937 p 553–575
(ORNL-TR-1102)

The mean mass defects of heavy atomic nuclei are calculated in an approximation which extends by one step beyond the Thomas–Fermi method. Since the mass defects obtained in this approximation are much closer to the empirical ones, than those obtained from the Thomas–Fermi method, the results of this study can serve as an argument for the new assumptions concerning nuclear forces, which were proposed by Breit, Condon, Present, Feenberg and by Volz. Author (NSA)

N66-32880# International Centre for Theoretical Physics, Trieste (Italy).
CABIBBO ANGLE AS A RENORMALIZATION EFFECT
P. Narayanaswamy and T. Pradhan 20 Apr. 1966 10 p refs
(IC-66-42)

It is shown that the Cabibbo sin θ factor can be understood as a renormalization effect if one uses the algebra of currents constructed from the phenomenological fields of hadrons to derive sum rules for the axial vector coupling constants in their β-decay. Author (NSA)

N66-32881# International Centre for Theoretical Physics, Trieste (Italy).
ON THE DYNAMICAL ORIGIN OF SU(6)
R. Delbourgo (Imperial Coll. of Sci. and Technol.), Abdus Salam, and J. Strathdee 26 Apr. 1966 7 p refs Submitted for Publication
(IC-66-41)

A relativistic dynamical model is considered for massive quark–antiquark binding which gives rise to the rest symmetry $U(6)_w \otimes O(3)$ for the meson bound states. The model may or may not be realistic: it does however show how much higher symmetries may emerge from dynamical approximations; it throws some light on the role of noncompact groups and it leads to a definite representation mixing. NSA

N66-32882# Princeton Univ., N. J. Palmer Physical Lab.
SUPERMULTIPLET THEORY
J. A. Flores Jan. 1966 29 p refs
(Contract AT(30-1)-937)
(PUC-937-201) CFSTI: HC $2.00/MF $0.50

A second-quantization formulation of the many-body problem and its group theoretical interpretation are described. A detailed discussion on supermultiplet classification of states is presented. As a final application of supermultiplet theory, eigenvalues of the exchange operators were obtained. NSA

N66-32883# Atomic Research Center (AEC), Manila (Philippines).
THE NUCLEAR FORCE EQUATIONS AND THE BOOTSTRAP HYPOTHESIS
Manuel R. Eugenio and Aida T. Davila May 1966 4 p ref
(PAEC(A)PH-663-A)

The relationships between nuclear force (or field) and nuclear mass are given. The relationships between nuclear binding energy (or potential) and nuclear mass are given. The nuclear forces and positive potentials are plotted against mass number A and compared. NSA

N66-32884# International Centre for Theoretical Physics, Trieste (Italy).
THE RELATION OF THE O(2,1) PARTIAL WAVE EXPANSION TO THE REGGE REPRESENTATION
J. F. Boyce Apr. 1966 40 p refs Submitted for Publication
(IC-66-30)

The general two-particle scattering amplitude is expanded in terms of partial waves corresponding to the crossed channel little group O(2,1). The invariance of the S-matrix under the complex Lorentz group which follows from the Gargmann–Hall–Wightmann theorem enables this expansion to be identified with the Regge representation in the crossed channel. Author (NSA)

N66-32885# Deutsches Elektronen–Synchrotron, Hamburg (West Germany).
WHAT IF ANYTHING IS SU(6) SYMMETRY?
P. Stichel Mar. 1966 12 p refs Presented at the 5th Intern. Univ. Week for Nucl. Phys., Schladming, Austria, 24 Feb.–9 Mar. 1966
(DESY-66/7)

The violation of some basic physical concepts caused by applying formal group theoretical methods to elementary particle physics is discussed. A critical review of SU(6) symmetry is presented. The basic ideas and the main defects of the different approaches within the SU(6) theory are discussed. The connections between the different approaches which are of a logical, quasi-logical, or non-logical nature are discussed. NSA

N66-32886# Oak Ridge National Lab., Tenn.
INTENSITY AND NATURAL WIDTH OF THE BLUE CESIUM DOUBLET, PART I
Wilhelm Schuetz [1966] 19 p refs Transl. into ENGLISH from Z. Phys. (Berlin), v. 84, 1930 p 682–696
(ORNL-TR-1180)

The total absorption is determined graphically and mathematically with consideration of the Doppler effect as a function of the number of disperion electrons on the path of the light beam. The newly determined transition range between the ranges of validity of the two limiting laws cited by Ladenberg and Reiche for very weak and strong absorption is particularly remarkable. In this transition region, the total absorption is practically independent of the number of dispersion electrons. The method of determining the ratio of the dispersion electrons responsible for the blue doublet from the total absorption in pure cesium vapor has proved to be unsuitable. A lower limit value of 3.6 is presumably obtained from the magnetic rotation, which can be considered as a preliminary result. The combination of the total absorption with the number of dispersion electrons determined from magnetic rotation results in the value $\omega_0 = 2.5 \cdot 10^7$ sec = 0.24 ω_{class} for the natural width of the lines. Due to the uncertainty of the reported numerical values resulting from the hyperfine structure, the investigation is being continued. Author (NSA)

N66-32887# Brookhaven National Lab., Upton, N. Y.
MEFF—AN IBM 7094 MONTE CARLO CODE FOR MUON–PROTON SCATTERING
Steven Bender, Stanely Kaplan, and Michael Tannenbaum (Columbia Univ., New York) 12 Apr. 1966 85 p
(Contract AT(30-2)-GEN-16)
(BNL-10166) CFSTI: HC $3.00/MF $0.75

Computer programs were written to determine the apparatus detection efficiency in terms of q^2, the 4-momentum transfer^2 of the collision, and the incident muon momentum at the point of interaction. Detailed listings of the programs and their functions are included. NSA

N66-32895# Oak Ridge National Lab., Tenn.
TOTAL ABSORPTION AS A MEASURE OF THE NUMBER OF DISPERSION ELECTRONS
Wilhelm Schuetz [1930] 19 p refs Transl. into ENGLISH from Z. Astrophys. (Heidelberg), v. 1, 1930 p 300–313
(ORNL-TR-1144)

It is shown that the "total absorption" of a spectroscopically unresolved absorption line is proportional to the root of the number of atoms in the absorbing vapor layer under suitable experimental conditions. However, if the number is sufficiently small, then the law of roots which was explained in theory by Ladenburg and Reiche no longer applies and the total absorption proves to be approximately independent of the number. This behavior is attributed in a more general connection to the influence of the Doppler effect and is given a theoretical explanation. A survey is presented of the absorption methods with special consideration of their fundamentals, their effectiveness, and their applicability. Author (NSA)

N66-32897# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
MEASUREMENT OF THE π^+p AND π^-p TOTAL CROSS SECTIONS FROM 700 to 1700 MeV AND APPLICATIONS TO THE DISPERSION RELATIONS [MESURE DES SECTIONS EFFICACES TOTALES π^+p ET π^-p ENTRE 700 ET 1700 MeV ET APPLICATIONS AUX RELATIONS DE DISPERSION]
Alexandre V. Stirling (Ph.D. Thesis) 1966 64 p refs In FRENCH
(CEA-R-2838)

The π^+p and π^-p total cross sections were measured between 500 and 1700 MeV to eliminate discrepancies in the experimental data. These new values have permitted a more precise calculation of the forward dispersion relation. These relations are well satisfied by the experimental data up to 18 BeV for charge exchange scattering. The dispersion relation for the spin-flip amplitude gives an efficient test for the phase-shift analysis solutions. Author (NSA)

N66-32898# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
DERIVATION OF SUM RULES FOR ELECTROMAGNETIC ISOVECTOR FORM FACTORS
G. Kramer and K. Meetz Apr. 1966 12 p refs
(DESY-66/8)

Starting with equal time commutation relations for the isospin current densities, sum rules for isovector form factors are derived in a manifestly covariant way. Locality is taken into account by means of dispersion relations. For scalar and pseudoscalar particles the most general sum rule is obtained. This sum rule is applied to electromagnetic form factors of mesons and nucleons. Author (NSA)

N66-32899# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.
A STATISTICAL ANALYSIS OF THE LIMIT ON THE BREAKDOWN OF QUANTUM ELECTRODYNAMICS ATTAINABLE WITH ELECTRON-POSITRON COLLIDING-BEAM MACHINES
U. Amaldi, Jr., R. Biancastelli, and P. Stein 15 Jan. 1966 35 p refs
(ISS-66/1)

In the hypothesis that there is no breakdown of quantum electrodynamics, the upper limits which can be put on a simple breakdown parameter performing $e^+ + e^- \rightarrow e^+ + e^-$, $e^+ + e^- \rightarrow \gamma + \gamma$ and $e^+ + e^- \rightarrow \mu^+ + \mu^-$ experiments at different energies with a "reasonable" apparatus are obtained. While the discussion of the $\mu^+\mu^-$ experiment is simple, the first two reactions, whose angular distribution is sensitive to the breakdown, are studied simulating experiments on the IBM 7040 computer and and then analyzing them by means of the maximum likelihood method. The effects of experimental inefficiencies and of errors introduced in correcting the data for radiative processes are considered. Author (NSA)

N66-32900# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
DISPERSION ANALYSIS OF ELASTIC SCATTERING OF HIGH-ENERGY PARTICLES [DISPERSIONNYI ANALIZ UPRUGOGO RACCEYANIYA CHASTITS V OBLASTI UYSOKIKH ENERGII]
V. S. Barashenkov 1966 45 p refs In RUSSIAN
(JINR-P-2582)

Experimental data on measurement of the real part of the elastic πN and NN scattering amplitude at zero angle are discussed. The experiment is compared with the results of dispersion calculations. Author (NSA)

N66-32901# Joint Inst. for Nuclear Research, Dubna (USSR).
RELATIVISTIC RECONSTRUCTION OF N-N SCATTERING MATRIX [RELYATIVISTSKOE VOSSTANOVLENE MATRITSY N-N RASSEYANIYA]
S. M. Bilen'kii, L. I. Lapidus, and R. M. Ryndin 1966 25 p refs In RUSSIAN
(JINR-P-2630)

It is shown how the nucleon-nucleon scattering matrix can be reconstructed from the experimental data at fixed values of the angle and energy in the relativistic case. Different reconstruction procedures are considered. Relativistic formulas were obtained for reconstructing nucleon-nucleon scattering matrix in the state with total non-zero isospin from the n-p and p-p scattering data. Author (NSA)

N66-32902# California Univ., Berkeley. Lawrence Radiation Lab.
DIFFERENTIAL DISTRIBUTIONS OF π^+ IN THE REACTION $\pi^-p \rightarrow \pi^+\pi^-n$ from 500 TO 700 MeV
Douglas Charles Giancoli (Ph.D. Thesis) 10 Mar. 1966 78 p refs
(Contract W-7405-ENG-48)
(UCRL-16282) CFSTI: HC $3.00/MF $0.75

The energy distributions of the π^+ in the reaction $\pi^-p \rightarrow \pi^+\pi^-n$ were measured at several π^+ angles for incident π^- beam energies of 516, 550, 599, 667, and 712 MeV. The negative-pion beam was obtained from the Berkeley Bevatron. The energies of the π^+ were measured with a magnetic spectrometer consisting of a C-magnet with thin-walled aluminum spark chambers to display the trajectory of the particle entering and leaving the magnet. An array of scintillation counters was used to detect the occurrence of an event. An electronic time-of-flight system was used to distinguish positive pions from protons, which also pass through the spectrometer. The distributions at each angle were integrated over energy to obtain the differential cross sections, $d\sigma/d\Omega^*$. The measured spectra cannot be adequately explained by the statistical model nor by an isobar model, although production of the N^*_{33} isobar is present. Author (NSA)

N66-32903# Atomic Research Center (AEC), Manila (Philippines).
THE NUCLEAR FORCE EQUATIONS
Manuel R. Eugenio and Aida T. Davila Apr. 1966 7 p ref
(PAEC(A)PH-663)

A binding energy per nucleon (B/A) curve was drawn and corrected for the Coulomb effect. An equation was fitted to the curve: $B/A=11.8\ (1-e^{-0.3\sqrt{A}})$. Through two differentiations and various numerical substitutions for A, some interesting relationships between nuclear force and nuclear matter were obtained. (NSA)

N66-32904# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

ON A LOCALIZATION OF RELATIVISTIC MICROPARTICLES IN SPACE TIME [O LOKALIZATSII RELYATIVISTSKIKH MIKROCHASTITS V PROSTRANSTVE I VREMENI]

D. I. Blokhintsev 1966 15 p refs In RUSSIAN
(JINR-P-2631)

It is shown that particles may be localized in positive energy states with any degree of accuracy if the quadratically integrable wave packets are considered instead of the eigenfunction of the coordinate operator. Author (NSA)

N66-32905# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.

INTERFERENCE OF $K_L \rightarrow \pi^+\pi^-$ AND $K_S \rightarrow \pi^+\pi^-$ DECAYS IN CORRELATION EXPERIMENTS WITH $K^0\ K^0$ PAIRS [INTERFERENTSIYA RASPADOV $K_L \rightarrow \pi^+\pi^-$ AND $K_S \rightarrow \pi^+\pi^-$ KORRELYATSION NYKH EKSPERIMENTAKH S PARAMI $K^0\ K^0$]

V. L. Lyuboshits and E. O. Okonov 1966 10 p refs In RUSSIAN
(JINR-P-2632)

The interference is considered of long-lived (K_L) and short-lived (K_S) neutral K-mesons into two charged π-mesons in the $K^\circ\ \bar{K}^\circ$ pair production. It is shown that the study of interference phenomena in the correlation experiments involving $K^\circ\ \bar{K}^\circ$ pairs allows one to determine the magnitude and relative phase of the small admixture states with even (or odd) orbital angular momenta in the $K^\circ\ \bar{K}^\circ$ system. Author (NSA)

N66-32964*# Washington Univ., St. Louis, Mo. Cosmic Ray Group.

AN APPARENTLY HIGH FLUX OF PRIMARY COSMIC-RAY γ-PARTICLES AT 41°N. MAG.

M. W. Friedlander and J. Klarmann Jun. 1966 23 p refs Submitted for Publication
(Grant NsG-185-61)
(NASA-CR-77000; CR-66-2) CFSTI: HC $1.00/MF $0.50
CSCL 20H

The flux of primary cosmic ray α-particles was measured in nuclear photographic emulsions exposed on a high altitude balloon flight. The flux value derived was 110 ± 8 particles/m^2 sec ster, substantially in excess of that expected on the basis of data obtained during the previous minimum in solar activity. A reexamination of published records of older flights shows that the geomagnetic cut-off values assumed were in error. Author

N66-33036# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France). Faculte des Sciences.

APPLICATION OF THE FADDEEV EQUATIONS TO THE DETERMINATION OF THE NEUTRON-NEUTRON LOW ENERGY PARAMETERS

M. Fontannaz Jul. 1966 14 p refs Supported in part by The Swiss Natl. Fund
(Th/158) CFSTI: HC $1.00/MF $0.50

The Faddeev equations are used in the framework of separable approximation in order to determine the parameters of the neutron-neutron system at low energy from the doublet neutron-deuteron scattering length ^2a. Author

N66-33038# Aktiebolaget Atomenergi, Stockholm (Sweden).

INTEGRAL PARAMETERS OF THE GENERALIZED FREQUENCY SPECTRA OF MODERATORS

S. N. Purohit Jun. 1966 32 p refs
(AE-228) CFSTI: HC $2.00/MF $0.50

A study of the integral quantities—M_2 (the second energy transfer moment of the scattering kernel weighted by the Maxwellian distribution), $(v\Sigma_s)_{min}$ (the minimum value of the scattering cross section times velocity), and the moments of frequency spectrum including the effective temperature and Debye–Waller integrals—in terms of the frequency spectrum of the dynamical modes is presented. Numerical results for H_2O, D_2O, Be, BeO and C using the available frequency spectra have been obtained. In the estimation of M_2 and $(v\Sigma_s)_{min}$ the first term of the Placzek mass expansion is obtained exactly and the correction by the Doppler approximation method. In addition, the exact results for the Doppler approximation and the gas model have also been given. Author

N66-33048# Israel Program for Scientific Translations, Ltd., Jerusalem.

A STUDY OF GAMMA-SPECTRA OF THERMAL-NEUTRON RADIATIVE CAPTURE BY ORE AND MINERAL SAMPLES

G. Aripov, B. E. Krylov, E. M. Lobanov, N. S. Matveev, M. M. Romanov et al *In its* Activation Analysis 1966 p 13–17 refs (See N66-33046 19-06) CFSTI: $4.00

The spectra of thermal neutron radiative capture in samples of ore minerals and ores were studied with a scintillation γ-spectrometer, to investigate the possibility of applying this technique to mineral prospecting. The procedure is outlined and the energy calibration curve of the spectrometer used is provided. The radiative capture spectra were taken by repeatedly measuring the pulse height spectra of the specimens. From these data, the most characteristic spectral region of each mineral was calculated. The spectra obtained for significant determinations are shown and the implications of this procedure are assessed. H.S.W.

N66-33050# Israel Program for Scientific Translations, Ltd., Jerusalem.

MEASUREMENT OF THE VAPORIZATION RATE OF ZIRCONIUM FROM A ZrC HOT CATHODE BY THE NEUTRON-ACTIVATION METHOD

I. A. Maslov and A. P. Obukhov *In its* Activation Analysis 1966 p 22–27 refs (See N66-33046 19-06) CFSTI: $4.00

Data is given from an experiment conducted to measure the vaporization rate of zirconium from a zirconium carbide hot cathode by the neutron activation method. It is reported that the identification was based on Zr^{95}, which has a long half life and therefore is suitable for analytical work. The procedures used are outlined, and at 2000°C the rate of vaporization was $(1-2)\times10^{-9}$ g/cm^2sec. Additional data are summarized in charts and graphs. H.S.W.

N66-33070# Israel Program for Scientific Translations, Ltd., Jerusalem.

DETERMINATION OF ELEMENTS OF HIGH THERMAL-NEUTRON-CAPTURE CROSS SECTIONS IN BENEFICIATION PRODUCTS BY THE NEUTRON-ABSORPTION METHOD

I. N. Plaksin, L. P. Starchik, and N. G. Malysheva *In its* Activation Analysis 1966 p 114–117 refs (See N66-33046 19-06) CFSTI: $4.00

For determining elements of high neutron-capture cross section, a cartridge filled with the sample was mounted in a flux of slow neutrons, and the neutrons passing through the sample were then counted. It is pointed out that shallow cartridges and correspondingly small weighed samples should be used to facilitate the determination, and to ensure a linear dependence of the neutron count rate on the concentration

of the relevant element. Figures are included to show the calibration graphs for the determination of (1) boron, the rare earths, mercury, and lithium in dry beneficiation products; (2) cadmium, boron, mercury, and lithium in solutions; and (3) boron, mercury, and lithium in the solid phases of a suspension. M.G.J.

N66-33071# Israel Program for Scientific Translations, Ltd., Jerusalem.
USE OF EXCITATION OF X-RAY FLUORESCENCE BY ALPHA-RADIATION IN THE ANALYSIS OF ORES AND BENEFICIATION PRODUCTS
I. N. Plaksin, M. A. Belyakov, and L. P. Starchik *In its* Activation Analysis 1966 p 118–121 refs (See N66-33046 19-06) CFSTI: $4.00

Several studies on X-ray fluorescence excitation are surveyed, and it is pointed out that, simultaneously with X-ray excitation, alpha particles can be applied to to excite radioluminescence in the visible spectrum. Such excitation of the heavy elements is considered most suitable for analytical purposes, since the X-ray quantum energy is roughly proportional to the square of the atomic number of the element. Hard X-rays are preferred, as the effect of absorption and self-absorption is negligible and better resolution of the photopeak is possible. The variation of the count rate of the characteristic X-rays of tin with the cassiterite content in a quartz mixture is examined. Also depicted is the yield of X-ray quanta of the excited K- and L-series vs the atomic number of the element for irradiation with Po^{210} alpha particles. M.G.J.

N66-33072# Israel Program for Scientific Translations, Ltd., Jerusalem.
QUALITY CONTROL OF BENEFICIATION PRODUCTS UTILIZING THE SCATTERING OF BETA-RADIATION
I. N. Plaksin, Ch. A. Aleksandrov, L. P. Starchik, and T. G. Tomov *In its* Activation Analysis 1966 p 122–125 refs (See N66-33046 19-06) CFSTI: $4.00

Details are given on the use of filters for increasing the accuracy of the determination, reducing the influence of impurities, and lowering the possible error due to redistribution of the weight concentrations of the impurities. The optimum filter thickness is obtained by plotting the absorption curves of beta radiation scattered by the principal components of the product being analyzed. It is shown that the intensity ratio of beta particles scattered by galena and sphalerite, and also by cassiterite and magnetite, increases with filter thickness. With filters of optimum thickness (360 mg/cm^2), these ratios are maximized. Further increase of filter thickness reduces the intensity ratio due to the gamma background which remains fairly constant. Reducing the influence of impurities on the determination of lead and tin by filtering is also considered. Procedures for measuring lead, tin, and mercury content in beneficiation products are discussed. M.G.J.

N66-33111# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.
ELECTRON-ION COLLISIONS. IA: CROSS SECTIONS FOR DISSOCIATION AND IONISATION OF CO^+
J. Cuthbert, J. Farren, B. S. Prahallada Rao, and E. R. Preece Mar. 1966 11 p refs
(AERE-M-1725)

Cross sections are calculated for the electron collisions with CO and CO^+. The basis of these calculations is a recent determination of the electron impact ionization cross section for CO near threshold. Author

N66-33140 European Organization for Nuclear Research, Geneva (Switzerland).
EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH, ANNUAL REPORT, 1965
[1966] 173 p refs
CFSTI: HC $5.00/MF $1.25

A report on developments in a European laboratory organized for nuclear research is presented. Illustrations accompany discussions on: proton synchrotron, synchro-cyclotron, nuclear physics, track chambers, data handling, theoretical studies, accelerator research, buildings and sites, finance, personnel, health physics, and central services. S.P.

N66-33175*# Stanford Research Inst., Menlo Park, Calif.
CLASSICAL AND QUANTAL SCATTERING. 1: THE CLASSICAL ACTION
Felix T. Smith 21 Sep. 1964 19 p refs Submitted for Publication
(Contract NASr-49(07))
(NASA-CR-59567) CFSTI: HC $1.00/MF $0.50 CSCL 20H

Classical scattering is based on the action $A = S - S_0$, where S is the action over the actual trajectory and S_0 is over the equivalent without interaction. For 2-body spherical potential scattering $A = \Delta(L,E) - L\theta$, where θ is the deflection angle and Δ is the classical phase, the classical limit of $2\hbar\delta_l(E)$. A new, rapidly convergent expression is given for $\Delta(L,E)$. From this is derived a convergent expansion in 1/E valid for fixed $L \neq 0$, and an equivalent form in 1/L valid for fixed E. The lowest term in 1/L agrees with Massey and Mohr, and higher terms are evaluated. Author

N66-33183*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THEORY OF PROTON–HYDROGEN COLLISIONS
Ian M. Cheshire [1964] 42 p refs Submitted for Publication
(NASA-TM-X-54929) CFSTI: HC $2.00/MF $0.50 CSCL 20H

The theory of excitation and charge exchange in proton–hydrogen collisions is discussed within the framework of the impact parameter method. Consideration is given to the importance of proper boundary conditions. The time dependent equations linking the amplitudes of the target with those of the rearranged system are written in matrix form. By eliminating the rearrangement amplitudes from these equations a second order matrix equation is derived which may be used as a basis for successive approximations which are automatically second order. The theory is generalized with the aid of a two center expansion of the electronic wave function. The method is illustrated by computing first and second order distortion approximation for the reactions $H^+ + H(1s) \rightarrow H^+ + H(2s)$ and $H^+ + H(1s) \rightarrow H(1s) + H^+$ and the results are compared with previous calculations. Author

N66-33191# Massachusetts Inst. of Tech., Cambridge. Lab. of Nuclear Science.
NUCLEAR CORE STRUCTURE OF SMALL EAS AT 5200 m ALTITUDE
M. La Pointe, H. Bradt, G. Clark, M. Oda, V. Domingo (San Andres Univ.) *In* Comision NACL. de Invest. Espaciales Proc. of the Regional Symp. of the Intern. Years of the quiet sun, vol. III 1965 8 p refs Prepared jointly with San Andres Univ. (See N66-33186 19-29) CFSTI: HC $4.00/MF $1.00
(Grant AF-AFOSR-546-64)

About 12,000 air showers with particles in the size range of 5×10^3 to 5×10^6 were surveyed using an array of particle detectors at Mt. Chacaltaya (5200 m altitude) consisting of unshielded density detectors, lead glass Cerenkov detectors, fast timing detectors, a 60 inch cloud chamber, and a 60 m^2 shielded mosiac of 4 m^2 scintillation detectors. The nuclear core structure of these small air showers, as determined from

the electron component, landed on or within 2 meters of the 60 m^2 shielded detector array in about 1400 cases. A preliminary study of these showers was conducted and several interesting features concerning (1) large fluctuations in the lateral distribution of nuclear energy near the shower core, (2) retention of a large fraction of the primary energy in a single residual nucleon or in a narrow cluster of nucleons, (3) occasional large lateral spread, and the (4) observation of tiny showers with large bursts are discussed. Schematic diagrams are depicted for (1) the muon detectors, (2) the nuclear bursts in the scintillation chamber, and (3) a proposed scintillation chamber. A series of tables indicating the numerical distribution of burst sizes in the shielded detectors is presented, along with a double graphic representation of the number of showers versus the size of the largest burst particles, and versus the approximate energies of the largest bursts. L.S.

N66-33194# Sao Paulo Univ. (Brazil).
AN ACCOUNT OF THE EMULSION CHAMBER PROJECT OF BRAZIL–JAPAN COLLABORATION
C. M. G. Orsini *In* Comision NACL. de Invest. Espaciales Prox. of the Regional Symp. of the Intern. Years of The Quiet Sun, vol. III 1965 8 p refs (See N66-33186 19-29) CFSTI: HC $4.00/MF $1.00

High energy γ-rays and nuclear interactions present in cascade showers were detected by nuclear emulsion chambers. The work effort was a collaboration between Brazilian and Japanese research teams; the plates being exposed in Chacaltaya, processed in Sao Paulo, and analyzed in both Brazil and Japan. A list of exposures up to the present time is given. A table of values for the energy spectrum power obtained with the present data compared with previously published values is also given, along with a plot of the spectrum obtained for the present experiments on Mt. Chacaltaya. Also depicted are: (1) a drawing of a typical family of particles from the showers, as seen on X-ray film, where 4 γ-rays and one secondary interaction were detected, (2) a correlation diagram showing the energy flow and lateral spread in the cascade showers by Monte Carlo calculation, and (3) graphs showing the transverse momenta distribution for pions which were detected. Experiments are continuing with a nuclear emulsion chamber of larger thickness (60 c.u.) to obtain information about the energy transfer in high energy interactions through successive collisions of the surviving nucleon. L.S.

N66-33196# Minnesota Univ., Minneapolis. School of Physics.
LOW ENERGY END OF THE PRIMARY PROTON, ALPHA PARTICLE AND HEAVIER NUCLEI SPECTRA
W. R. Webber *In* Comision Nacl. de Invest. Espaciales Proc. of the Regional Symp. of the Intern. Years of the Quiet Sun, Vol. III 1965 16 p (See N66-33186 19-29) CFSTI: HC $4.00/MF $1.00

Measurements of the low energy end of the primary spectra of protons, helium nuclei, light nuclei (lithium, beryllium, and boron), medium nuclei, and heavy nuclei, are discussed. The peaks which occur in the differential spectra are at different rigidities for the different charge components. Some of the features and the significance of the peaks in the low energy part of the primary spectrum are briefly outlined. Characteristics of solar modulation effects that may produce some of these peaks are discussed in relation to the charge dependence and the energy dependence. Data plots of the spectra are depicted, compared, and interpreted. L.S.

N66-33229# Rochester Univ., N. Y. Dept. of Physics and Astronomy.
COUPLING AND RECOUPLING OF RELATIVISTIC STATES. II: NOTE ON THE SYSTEMATICS OF MANY PARTICLES SYSTEMS
Haim Goldberg 1 Apr. 1966 24 p refs Submitted for Publication
(Contract AT(30-1)-875)
(UR-875-134; AD-633761) CFSTI: HC $1.00/MF $0.50

The direct product of many irreducible representations of the Poincaré group is discussed. A procedure is suggested for the decomposition in the canonical scheme, which is not an iteration of the 2-particles method. Also, it is independent of the c.m.s. Corresponding expression for S-matrix elements of many particle processes is given. The properties of the invariant functions associated with elastic scattering in case of parity, time reversal and crossing symmetries is discussed, as well as in case of identical particles. Author (TAB)

N66-33373*# National Aeronautics and Space Administration, Washington, D. C.
A NEW APPROACH TO THE HOMOGENIZATION OF HETEROGENEOUS MEDIA FOR NEUTRON DIFFUSION CALCULATIONS
A. Jacobs [1960] 62 p refs Submitted for Publication
(NASA-TM-X-54846) CFSTI: HC $3.00/MF $0.75 CSCL 07D

Presented is a mathematical formulation and physical interpretations for neutron diffusion in media pierced by vacuum channels. Time dependent transport equations are developed by considering both, the neutron flux and the collision density, as dependent variables of an angular-dependent mean free path. It is developed that these theoretical methods give different results when low-order approximations are employed in the solution of the transport equation. G.G.

N66-33384*# Maryland Univ., College Park. Inst. for Molecular Physics.
HIGHER-ORDER STATIONARY PHASE APPROXIMATIONS IN SEMICLASSICAL SCATTERING
Francis J. Smith, E. A. Mason, and J. T. Vanderslice 30 Nov. 1964 29 p refs Submitted for Publication
(Grant NsG-5-59)
(NASA-CR-59822; IMP-NASA-43) CFSTI: HC $2.00/MF $0.50 CSCL 20H

Higher-order stationary phase approximations are used to calculate corrections to the classical expression for the differential cross section for elastic scattering. An expansion for the cross section as a series in n^2 is obtained, whose first term is the classical result. An oscillating term is also present, whose "wavelength" is approximately $\Delta\theta \approx 2\pi/kb$. Both the "wavelength" and the amplitude of this term vary as n. It is shown that the classical differential cross section is valid for angles as small as the critical angle defined by Massey and Mohr. Author

N66-33385*# Haverford Coll., Pa. Strawbridge Observatory.
OSCILLATOR STRENGTHS AND HIGH ACCURACY WAVE FUNCTIONS FOR NEUTRAL HELIUM
Louis C. Green, Eleanor K. Kolchin, and Norma C. Johnson [1963] 20 p refs Submitted for Publication
(Grant NsG-287; Contracts Nonr-1727(00); AT(30-1)-2934)
(NASA-CR-59516) CFSTI: HC $1.00/MF $0.50 CSCL 20J

Oscillator strengths have been computed for the $p^1S - n^1P$ series of HeI. The computations were carried through with wave functions determined by the minimum principle and employed central field functions and configuration interaction. The agreement between the oscillator strengths as computed by the length, velocity, and acceleration expressions

and the agreement between the present work and the very extensive computations of Schiff and Pekeris for the transitions 1^1S-2^1P and 1^1S-3^1P give confidence in the effectiveness of the method and the dependability of the results. Author

N66-33415*# Maryland Univ., College Park. Inst. for Molecular Physics.

COLLISION INTEGRALS FOR THE EXPONENTIAL ATTRACTIVE POTENTIAL

R. J. Munn, E. A. Mason, and Francis J. Smith 30 Nov. 1964 14 p refs Submitted for Publication

(Grant NsG-5-59)

(NASA-CR-59939; IMP-NASA-44) CFSTI: HC $1.00/MF $0.50 CSCL 20H

Collision integrals for the exponential attractive potential are calculated by accurate numerical integration. There are some unexpected differences from what had been expected by analogy with inverse power attractive potentials. Some implications of these results for the calculation of high-temperature gas transport properties are discussed. Author

N66-33434*# Oak Ridge National Lab., Tenn.

EFFICIENCY OF ORGANIC SCINTILLATORS FOR FAST NEUTRONS

R. J. Schuttler Jul. 1966 71 p refs

(NASA Order R-104; Contract W-7405-ENG-26)

(NASA-CR-76860; ORNL-38888) CFSTI: HC $3.00/MF $0.75 CSCL 18K

Organic scintillator detection efficiencies are estimated for incident neutrons above 12 MeV, in which region nonelastic reactions in the carbon of the detector become significant. The efficiency is given in a first effective collision approximation, later corrected for second-collision effects, as a function of a detector threshold on the fast component of the light from the phosphor. The analysis includes consideration of nonlinear light production of both fast- and slow-light components, pulse-shape discrimination against gamma rays, the detector's pulse-height resolution, and edge effects. Effective carbon cross sections are approximated by combining a Monte Carlo intranuclear cascade and evaporation contribution with the experimental $^{12}C(n,\alpha)^9Be$ cross section. Pulse heights are summed from the series of particles emitted in the reaction of a given incident neutron with a carbon nucleus, including pulses from secondary neutron interactions. For 14.5-MeV incident neutrons onto NE-213 detectors 2.61 and 6.1 cm thick, the method yields efficiencies of 9.7 and 21.7% for a fast-light threshold equivalent to pulses from 200-KeV electrons, if no pulse-shape discrimination against gamma rays is employed. Author

N66-33508# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

POPULATION DISTRIBUTIONS DURING VIBRATIONAL RELAXATION OF DIATOMIC GASES

J. W. Rich and R. G. Rehm Apr. 1966 32 p refs

(Contract AF 49(638)-1488)

(CAL-AF-2022-A-1; AFOSR-66-0720; AD-634437) CFSTI: HC $2.00/MF $0.50

A master equation analysis for the vibrational relaxation of a diatomic gas is presented, including the effects of near-resonance exchange of vibrational energy between colliding oscillators. It is found that the mechanism of rapid near-resonance exchange of vibrational energy among the diatomic species tends to maintain a quasi-steady state vibrational population distribution during the relaxation of a pure gas. The specific functional form of this quasi-steady state distribution is determined from a perturbation analysis of the master equation. A detailed analysis is also given of the relaxation equations for the case of equi-distant vibrational energy level spacing. It is found that when the diatomic gas is diluted by an inert to the extent that oscillator-oscillator exchange collisions no longer influence relaxation, the vibrational population distribution can depart markedly from the Boltzmann form. Whenever exchange collisions predominate, however, it is found that a near-Boltzmann distribution is preserved, regardless of the form of the vibration-translation transition probabilities, and the energy relaxation equation does not differ greatly from the Landau-Teller result. Author (TAB)

N66-33513# Aerospace Research Labs., Wright-Patterson AFB, Ohio.

LIMITATIONS IN THE ENERGY RESOLUTION OF SLOW ELECTRONS

Walter Friz Apr. 1966 34 p refs

(ARL-66-0061; AD-634517) CFSTI: HC $2.00/MF $0.50

The study of delineates quantitatively the limiting factors in resolution in electron spectrometry at very low energies. It is shown that monochromatic electron beams with energy spread $\Delta E/E = 10^{-3}$ may be produced well below 1 eV provided the necessary and quite possible technologyical effort is being made. It appears that in conjunction with standard detection schemes space charge effects and their restrictions on beam intensities pose a lower energy limit for attainable monochromatic beams. However, using coincidence counting detection schemes much lower beam intensities will suffice and then physical-chemical surface effects on the electrodes and their influence on the electron trajectories will be determining this limit. Author (TAB)

N66-33556# California Univ., Berkeley. Lawrence Radiation Lab.

COLLECTIVE POTENTIAL ENERGY, QUANTUM MECHANICAL FLUCTUATIONS AND TUNNELING EFFECTS IN EVEN NUCLEI, PART I

Krishna Kumar Mar. 1966 48 p refs

(Contract W-7405-ENG-48)

(UCRL-16788) CFSTI: HC $2.00/MF $0.50

A dynamical description of collective quadrupole motion is given. Quantum mechanical fluctuations of nuclear shapes and their effects on coupling between rotations and vibrations, and between β-vibrations and γ-vibrations, are investigated. These effects indicate the need of a more complicated β-, γ-dependence of the collective potential energy than that used in the past. A potential function, which is an extension of the Myers-Swiatecki potential, is suggested. On using this extended potential, good agreement is obtained with the experimental energy levels and B(E2) values of ^{154}Sm. The general nature of the potential is utilized to gain some qualitative understanding of other nuclei. A metastable band, which represents quantum mechanical tunneling and which can decay to the ground band only through a cascade involving one of the excited bands, is predicted. Author (NSA)

N66-33565# Atomics International, Canoga Park, Calif.

SPACE-TIME FLUX SYNTHESIS METHODS FOR THE APPROXIMATE SOLUTION OF TIME-DEPENDENT BOLTZMANN NEUTRON TRANSPORT EQUATION

V. Luco 25 May 1966 37 p refs

(Contract AT(11)1)-GEN-8)

(NAA-SR-11821) CFSTI: HC $2.00/MF $0.50

Space-time flux synthesis methods for the approximate solution of the time-dependent Boltzmann neutron transport equation are formulated. The variational and the Galerkin technique are used. The space-dependent part of the solution is obtained with the DTF-11 program—an Sn-type solution of the transport equation. Temperature feedback effects are considered in the formulation. The formulation presented here is adapted to the description of rapid transients following a large reactivity input, but the method can be easily modified to cover other reactor problems where a space-time

flux description is necessary. It should be useful whenever the situation requires the transport approximation for the description of the neutron flux. Author (NSA)

N66-33664 University Coll., Cardiff (Wales). Dept. of Applied Mathematics.
PHONON CASCADE THEORY Scientific Report No. 5
E. F. Smith and P. T. Landsberg Nov. 1965 52 p refs
(Contract AF 61(052)-664)
(AFCRL-66-222; AD-634445) CFSTI: HC $3.00/MF $0.50

A generalized formulation is given of the Lax electron cascade capture model. An electron capture cross section is obtained, via an essentially classical argument, in terms of quantum mechanical transition probabilities, which may include various suitable electron–boson interactions. The electronic potential energy, in the presence of an impurity center, was assumed to behave as r–n. Cross sections were obtained for the electron acoustic and optical phonon interactions. In the latter case cross sections were obtained for both neutral (N=4) and Coulomb attractive centers (N=1), in germanium and silicon, the sticking probabilities being taken from previous literature. When comparable with earlier work, the cross sections obtained are smaller (by at most a factor 10). New estimates include cross sections for electron capture by neutral centres in silicon, with optical phonon emission, over a range of temperatures. Author (TAB)

N66-33777# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Physics.
IONIZATION AND DISSOCIATIVE IONIZATION OF O_2 AFTER ELECTRON AND ION IMPACT Scientific Report No. 4
H. Sjogren and E. Lindholm 15 Dec. 1965 26 p refs
(Contract AF 61(052)-762)
(AFCRL-66-436; AD-634954) CFSTI: HC $1.00/MF $0.50

The ionization of O_2 was investigated by using charge exchange in a double mass spectrometer. The breakdown graph was constructed. A break in the electron impact ionization efficiency curve is explained as being due to ion–molecule reactions between excited O^+ ions formed in an ion-pair process, and O_2. It is shown that the cross sections must be very small for the reaction O^+ (quadruplet-s) + O_2 to O + O_2^+ since the cross sections for the corresponding reaction with Si^+ are small. Implications for the aeronomy are discussed. Author (TAB)

N66-33850# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A STUDY OF THE S^{36} (p, γ)Cl^{37} REACTION WITH BOMBARDING ENERGIES IN THE 790-KeV TO 1820-KeV RANGE
Jerry Joseph Perrizo (M.S. Thesis) Feb. 1966 65 p refs
(GSP/PHYS/66-16; AD-633731) CFSTI: HC $3.00/MF $0.75

A search for resonances in the S^{36} (p, γ-ray) Cl^{37} reaction was conducted using protons with energies in the 790-KeV to 1820-KeV range. Approximately 80 previously unreported resonances were found in the energy region studied. The observed widths appear to be due to target thickness and instrumental effects. The intrinsic strengths, obtained by normalizing the relative strength of each S^{36} resonance to that of the 1214-KeV resonance in the S^{34} (p, γ-ray) Cl^{35} reaction, ranged from 0.02 eV to 1.16 eV. Preliminary analysis of data obtained from γ-ray spectra has shown evidence for possible new low-lying levels in Cl^{37} at 4.3 and 5.4 MeV. Author (TAB)

N66-33867# Washington Univ., Seattle.
(α ^{7}Li) REACTIONS ON ^{11}B, ^{15}N, AND ^{19}F AT 42 MeV
Paul Mizera, J. B. Gerhart, and F. Slee Apr. 1966 11 p
(Contract AT(45-1)-1388)
(RLO-1388-5) CFSTI: HC $1.00/MF $0.50

The pickup of 3 nucleons from the 1p and 2s, 1d shells using 42-MeV alpha partciles from the 60" cyclotron at the University of Washington is discussed. The experimental technique is briefly outlined. Angular distributions and cross sections are among the results discussed. Author (NSA)

N66-33871# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
MESON-BARYON FORWARD SCATTERING IN RELATIVISTIC THEORY OF SPIN AND UNITARY SYMMETRY [MEZON-BARIONNOE RASSEYANIE VPERED V RELYATIVISTSKOI TEORII SPINOVOI UNITARNOI SIMMETRII]
O. G. Bokov, Nguyen Van Hieu, and B. Sredniava 1966 22 p refs *In* RUSSIAN
(JINR-P-2665)

All possible relations among meson-baryon scattering amplitudes are systematically studied in the scheme of $SU(6)_w$ symmetry. In the frame of U(6,6) the most general expression including 30 regular and irregular amplitudes is obtained for the forward meson-baryon scattering matrix element, the latter being invariant under $SU(6)_w$. The method applied here differs from that developed by (J. C. Carter, et al., Phys. Rev. Lett. 15, 373 (1965)). It is shown that many relations which were obtained by Carter, et al., for the forward meson-baryon scattering cross sections are not the consequences of $SU(6)_w$ as they hold only in the non-relativistic limit, provided only regular amplitudes are taken into account. Author (NSA)

N66-33873# International Centre for Theoretical Physics, Trieste (Italy).
SATURATION OF THE SU(3) ALGEBRA OF CURRENT DENSITIES
R. Oehme 12 May 1966 9 p refs
(IC-66-49)

The SU(3) algebra of vector current densities is saturated with octet and decimet states of baryons at infinite momentum and finite momentum transfer. The results are consistent with those of collinear U(6). They are in good agreement with experiments. Author (NSA)

N66-33874# International Centre for Theoretical Physics, Trieste (Italy).
PARTICLE MIXING AND $J^P=2^+$ MESON DECAYS
R. J. Rivers Apr. 1966 23 p refs
(IC-66-37)

Particle mixing for meson fields of arbitrary spin is considered in a field-theoretic context. Expressions for the field renormalization constants and mixing parameters are given in terms of the physical masses, assuming Okubo-type octet breaking. Broken SU(3) coupling constants are evaluated for the 2^+ meson decays and the predicted partial widths compared with experiment. Satisfactory agreement is found. Author (NSA)

N66-33875# International Centre for Theoretical Physics, Trieste (Italy).
DEGENERATE REPRESENTATIONS OF NON-COMPACT UNITARY GROUPS. II. CONTINUOUS SERIES
J. Fischer and R. Raczka Apr. 1966 24 p refs Submitted for Publication
(IC-66-36)

Three degenerate principal series of irreducible unitary representations of an arbitrary non-compact unitary group U(p,q) are derived. These series are determined by the eigenvalues of the first- and second-order invariant operators, the

former having a discrete spectrum and the latter a continuous one. The explicit form of the corresponding harmonic functions is derived and the properties of the continuous representations are discussed. Author (NSA)

N66-33876# International Centre for Theoretical Physics, Trieste (Italy).
ALGEBRA OF CURRENTS AND ω–ϕ MIXING ANGLE
M. P. Khanna and A. Vaidya 11 May 1966 9 p refs Submitted for Publication
(IC-66-47)

The equal time commutation relations of integrated currents are applied to the ω–ϕ system. In particular, the value of the ω–ϕ mixing angle is deduced. Some of these results are used to test the models of elementary particles as proposed by Okubo, showing the Gell-Mann–Zweig quark model is more favorable to the Maki–Hara quark model. Author (NSA)

N66-33878# Academia R. P. R., Bucharest (Romania). Institutul de Fizica Atomica.
ELASTIC SCATTERING OF PHOTONS BY A HYDROGEN ATOM
M. Gavrila and D. H. Constantinescu 1965 26 p refs Submitted for Publication
(IFA-FT-56)

The Kramers–Heisenberg formula for elastic scattering of photons by atomic hydrogen in the dipole approximation is evaluated for all values of the photon energy. The method used is half analytical–half numerical and consists in approximating the integrands of some final integrals which result after transforming the matrix element, by functions which can be integrated in closed form. The calculations are tedious and yield an elementary though rather lengthy formula for the matrix element. This was also computed numerically. A discussion of the result and a comparison with previous results are given. Author (NSA)

N66-33881# Academia R. P. R., Bucharest (Romania). Institutul de Fizica Atomica.
NEUTRON TRANSPORT THEORY—BIBLIOGRAPHY
Teordor Rosescu, comp. 1965 135 p Submitted for Publication
(IFA-FR-48)

Included is a list of 1200 references covering the period 1930–Aug. 1965 on neutron transport theory. NSA

N66-33882# Istituto Superiore de Sanita, Rome (Italy). Laboratori di Fisica.
KINEMATICS OF THE (e, e'p) REACTION [CINEMATICA DELLA REAZIONE (e, e'p)]
D. Guicci 23 Dec. 1965 102 p In ITALIAN Submitted for Publication
(ISS-65/49)

The kinematics of collision between electrons and nucleons bound in a nucleus are described. A computing program, coded in Fortran IV for the IBM 7040 electronic computer, as well as some kinematic tables concerning the reaction produced by electrons on protons in a nucleus, is included. Author NSA

N66-33883# National Inst. for Research in Nuclear Science, Harwell (England). Rutherford High Energy Lab.
LECTURES ON ELEMENTARY SCATTERING THEORY
D. P. Jones Dec. 1965 52 p Lectures presented at Bristol Univ. (England), Spring 1965 Submitted for Publication
(RHEL-R-108) HMSO: 8s

Eight lectures on the following aspects of elementary particle scattering theory are presented; the density matrix, partial wave expansion, polarized target experiments, nucleon–nucleon scattering, hyperon decay, ambiguities in scattering amplitudes, energy dependence of cross sections, and miscellaneous topics of high energy scattering. NSA

N66-33886# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
DIFFRACTION EFFECT IN THE ANGULAR DISTRIBUTION OF TRANSFER REACTION PRODUCTS [DIFRAKTSIONNYI EFFEKT V UGLOVOM RASPREDELENII PRODUKTOV REAKTSII PEREDACHI]
F. A. Gareev, Ya. Grabovskii, and B. N. Kalinkin 1966 10 p refs In RUSSIAN
(JINR-P-2664)

The diffraction effect in the angular distribution of the transfer reaction products was treated. It relation to the parameters of the problem of collision between nuclei is established. It is qualitatively explained why there exists an asymmetry in the half widths of the energy spectrum of the stripping and pickup reaction products. Author (NSA)

N66-33888# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ON THE ROLE OF QUASIPARTICLE INTERACTION WITH PHONONS IN ODD–ODD DEFORMED NUCLEI [O ROLI VZAIMODEISTVIYA KVAZICHASTITS S FONONAMI V NECHETNO–NECHETNYKH DEFORMIROVANNYKH YADRAKH]
V. G. Solov'ev 1966 8 p refs In RUSSIAN
(JINR-P-2622)

The effect of quasiparticle interactions with phonons on the structure of the ground and excited states of even deformed nuclei was investigated. This interaction is shown to be of great importance in the case of odd–odd nuclei and inessential in even–even nuclei. Author (NSA)

N66-33893# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
INVESTIGATION OF SHOWERS PRODUCED BY 45, 130, 230, AND 330-MeV ELECTRONS IN LEAD [ISSLEDOVANIE LIVNEI, OBRAZOVANNYKH ELEKTRONAMI S ENERGIEI 45, 130, 230 I 330 MeV V SVINTSE]
O. A. Zaimidoroga, Yu. D. Prokoshkin, and V. M. Tsupko-Sitnikov 1966 22 p refs In RUSSIAN
(JINR-P-2663)

Showers generated by $45\pm5^{-}$ $130\pm10^{-}$ $230\pm15^{-}$, and $330\pm20^{-}$ MeV electrons in lead were studied with a multiplate cloud chamber. Cascade curves and angular distributions of secondary electrons were obtained, the track length of showers were determined. Author (NSA)

N66-33895# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
ON A QUASILINEAR THEORY OF APERIODIC INSTABILITIES [K KVAZILINEINOI TEORII APERIODICHESKIKH NEUSTOICHIVOSTEI]
E. A. Perel'shtein 1966 8 p refs In RUSSIAN
(JINR-P-2648)

The problem is considered as to how the qualitative results of the quasilinear theory of aperiodic instabilities depend on the initial distribution function. The aperiodic instabilities are known to be determined by the collective interaction of all the particles and it seems that the results of the theory must not depend on the character of the distribution function. It is shown that the closing of instabilities in the quasilinear theory depends essentially on a form of the initial distribution function. Author (NSA)

N66-33902# Stanford Univ., Calif. Linear Accelerator Center.
INTENSE EMISSION OF SECONDARY ELECTRONS BY INCOMPACT LAYERS BaF_2 [HOHE SEKUNDAEREMISSION AUS BaF_2-SCHICHTEN GERINGER DICHTE]
Hellmut Seiler and Manfred Staerk [1965] 15 p refs Transl. into ENGLISH from Z. Angew. Phys. (W. Berlin), v. 19, no. 2, 1965 p 90–93
(SLAC-TRANS-40)

Goetze's field-intensified emission of secondary electrons was investigated in reflection on incompact layers of barium fluoride flashed onto a firm copper support in an argon atmosphere under a pressure of a few millimeters of mercury. The yield of the secondary electrons emitted was measured at various energies (10 to 50 keV) of primary electrons and various collector potentials (50 to 400 V). This yield was found to increase with increasing collector potential and decreasing primary electron energy. The half-width value of the energy distribution of secondary electrons was found to increase with increasing collector potential and therefore with increasing secondary electron yield. Whereas, at a primary electron energy of 10 keV, compact barium fluoride gave a secondary electron yield of only 0.9 (half-width value 8 eV), an incompact layer of barium fluoride gave, at a collector potential of 300 V, a secondary electron yield of about 20 (half-width value 17 eV). Author (NSA)

N66-33904# Atomic Energy Centre, Dacca (Pakistan).
OPTICAL MODEL CALCULATIONS OF ELASTIC SCATTERING IN LIGHT NUCLEI
M. Rahman, A. H. Knan, and H. M. Sen Gupta Mar. 1966 12 p refs
(AEDC-TP-7)

Diffuse surface optical model analyses were carried out to fit experimental elastic angular distributions in p–^{4}He, d–^{4}He and ^{3}He–^{4}He systems and best fit parameters were obtained. Author (NSA)

N66-33906# Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria).
NUCLEAR PHYSICAL STUDIES AT THE SEIBERSDORF REACTOR CENTER [KERNPHYSIKALISCHE ARBEITEN IM REAKTORZENTRUM SEIBERSDORF]
Peter Weinzierl 1965 28 p refs In GERMAN
(SGAE-PH-34/1965)

A review is given of the principal areas of investigation undertaker at the Seibersdorf Reactor Center. Among the studies discussed are the design and development of an electromagnetic mass separator, measurement of neutron capture cross sections, neutron decay, and the prompt γ scattering in nuclear fission. Typical results are given. NSA

N66-33907# International Centre for Theoretical Physics, Trieste (Italy).
UNIVERSAL COUPLING OF VECTOR MESONS REVISITED
W. Krolikowski Apr. 1966 14 p refs Submitted for Publication
(IC-66/34)

It is shown that "the partial conservation of a tensor current" (PCTC) leads to a universality of vector meson interactions, without assuming the Sakurai hypothesis on universal coupling of vector mesons to currents of symmetry generators. Meson electromagnetic decays are discussed on the grounds of PCTC and the results compared with the Sakurai universality. Author (NSA)

N66-33910# California Univ., Livermore. Lawrence Radiation Lab.
ELEMENTAL ANALYSIS USING NEUTRON INELASTIC SCATTERING
James A. Waggoner and Richard J. Knox [1965] 36 p refs (Contract W-7405-ENG-48)
(UCRL-14654-T) CFSTI: HC $2.00/MF $0.50

The technique of elemental analysis by analysis of the gamma rays resulting from the inelastic scattering of 14-MeV neutrons is described. This method is especially suitable for analysis of the major constituents of bulk samples such as planetary surfaces. Sample size, limits of sensitivity for Fe, Si, O, Mg, Al, Na, K, and Ca, detector resolution, shielding requirements, and geometrical effects are considered. An instrument designed for planetary surface analysis is described as one possible application of this method. This instrument weighs about 15 pounds and includes a pulsed source of 14-MeV neutrons, a gamma ray detector, and a 256 channel pulse height analyzer as well as the necessary electronics. Author NSA

N66-33912# Oak Ridge National Lab., Tenn.
MEASUREMENTS OF LOW ENERGY NEUTRON CROSS SECTIONS OF NON-FISSILE NUCLIDES AND THEIR INTERPRETATION
J. A. Harvey [1966] 36 p refs Presented at Am. Phys. Soc. Conf. on Neutron Cross Sect. Technol., Washington, D. C. (Contract W-7405-ENG-26)
(ORNL-P-2091; CONF-660303-29) CFSTI: HC $2.00/MF $0.50

Transmission, capture, and scattering measurements can be made with high resolution and accuracy up to 100 eV upon any non-fissile stable nuclide if a suitable sample (~grams) is available. These measurements can be analyzed by the shape or area method to give accurate parameters for all but the very small resonances. Measurements upon small samples (~mgms) with low isotopic enrichment or which are highly radioactive can give accurate parameters up to ~10 eV and for the strong resonances up to ~100 eV. Cross section measurements and resonance analysis of several nuclides which are or have been of interest in the design of thermal and intermediate energy reactors are described. Author (NSA)

N66-33920# Naval Radiological Defense Lab., San Francisco, Calif.
NUCLEAR-CHARGE DISTRIBUTIONS OF SEVERAL FISSION PRODUCT MASS CHAINS
P. O. Strom, D. L. Love, A. E. Greendale, A. A. Delucchi, D. Sam et al 5 Nov. 1965 27 p refs
(Contract AT(49(22)-1167)
(USNRDL-TR-935) CFSTI: HC $2.00/MF $0.50

Information on the nature of nuclear charge distribution in thermal-neutron fission of ^{235}U was obtained from measurements of fission yields of the major constituents in each of three adjacent mass chains. A regular variation in the width of the charge distribution curves with mass number was observed, and values of the most probable nuclear charge were determined. No effects attributable to the 50-proton or 82-neutron closed shells were observed in the charge distribution curves examined. Author (NSA)

N66-33921# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics.
DIFFERENTIAL CROSS SECTIONS FOR D(t,α)n REACTION IN THE ENERGY RANGE 115–1650 KeV [DIFFERENTSIALNYE SECHENIYA REAKTSII D(t,α)n V INTERVALE ENERGII 115–1650 KeV]
A. P. Kobsev, V. I. Salatskii, and S. A. Telezhnikov 1965 10 p refs In RUSSIAN
(JINR-P-2386)

The differential cross sections for the D(t,α)n reaction were measured at 90° in the lab system in the energy range 115–1650 KeV. The reaction cross sections measured earlier by others in the energy range from 115 up to 300 KeV and from 1450 up to 1650 KeV were confirmed. A difference (up to 10%) in the cross sections was found if compared with the earlier obtained data in the energy region from 300 up to 1450 KeV. Author (NSA)

N66-33922# Oak Ridge National Lab., Tenn.
PHYSICAL PROBLEMS OF DOSIMETRY OF NEUTRONS AND PROTONS

J. A. Auxier [1965] 21 p refs Presented at Symp. on Accidental Irradiation at Place of Work, Nice
(Contract W-7405-ENG-26)
(ORNL-P-2105; CONF-660412-1) CFSTI: HC $1.00/MF $0.50

For convenience, the problems associated with the physical dosimetry of neutrons and protons are divided roughly into two groups—those for neutrons and protons of less than 20 Mev and those for neutrons and protons of 20 Mev and greater. For absorbed dose measurements, the assumption of equilibrium of incident and secondary particles cannot be applied to the higher energy region, and, in general, measurements of flux and at least a crude measurement of particle spectra must be made. Fortunately, there are several convenience detectors by which flux may be measured, e.g., the $^{12}C(n,2n)^{11}C$ reaction and the $^{12}C(p,np)^{11}C$ reaction. Similar reactions are useful for the energy region below 20 Mev, e.g., the widely used threshold detector systems, and in addition the energy region lends itself to absorbed energy measurements based on the Bragg–Gray principle, i.e., assuming that equilibrium of primary and secondary particles is possible. In general, protons of less than 20 Mev are not an important practical problem due to their low penetrating power. Neutrons from fission sources and low-energy accelerators are by far the most important sources of personnel exposures in the region below 20 Mev, and they are also the energies most commonly used in radiobiological research. For both energy regions, it is now considered most important to determine sufficiently the parameters associated with radiation field such that the most fundamental interaction phenomena may be computed. Particularly important are the linear energy transfer (LET) distribution and the macroscopic distribution of dose throughout the organism, including the various organs in the larger organisms such as man. The emphasis of research at the present time is upon physical measurements at a sufficiently definitive level that comparisons can be made with comprehensive calculations using digital computers, so that once a computation technique is proven it can be used to compute the various parameters in more detail than can be accomplished practically with experimental methods. Author (NSA)

N66-33930# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Obninsk (USSR). Fiziko-Energeticheskii Institut.

SPECTRA OF INELASTIC SCATTERING OF NEUTRONS WITH INITIAL ENERGY OF 14.1 MeV AND DENSITY OF NUCLEAR LEVELS [SPEKTRY NEUPRUGO RASSEYANNYKH NEITRONOV S NACHAL'NOI ENERGIEI 14.1 MeV I PLOTNOST'YADERNYKH UROVNEI]

O. A. Sal'nikov, N. I. Fetisov, G. N. Lovchikova, G. V. Kotel'nikova, B. V. Devkin et al [1965] 18 p refs In RUSSIAN
(FEI-30)

The spectra of secondary neutrons formed in the interaction of 14.1-Mev neutrons with the nuclei of Be, Na, Mg, S, K, Ca, In, Sb, I, Cs, Ce, Ta and Hg were measured, establishing the relationship between the nuclear temperature, the density parameter of the nuclear surfaces and the mass number A. The mechanism of the (n,n') reactions and the spectra of neutrons generated by the (n,2n) reaction were also clarified. Annular scatterers were used in the experiments, holding Na, K, I, Cs and Hg in suitable containers. The results presented reflected a consideration of the correction for the dead time of the spectrometer, activation of the samples, effect of the scatterer, background, and the photomultiplier noise. On the basis of the experimentally measured scattered neutron spectra N(E), graphs of $\ln[N(E)/E]$ and $\ln[N(E)/E^{5/11}]$ were plotted. It was found possible to obtain inelastically scattered neutron spectra of medium and heavy nuclei through the nuclear temperature. On the basis of the linear correlation between IN/E and E it was found that if the initial neutron energy is 14.1 Mev, at least 80% of the scattering results in the formation of new nuclei. Change of the nuclear temperature with the excitation energy agrees with the Fermi gas model. The level density increases with the mass number, except for nuclei closed to filled shells. NSA

N66-33931# Gosudarstvennyi Komitet Po Ispolzovaniyu Atomnoi Energii, Obninsk (USSR). Fiziko-Energeticheskii Institut.

ANGULAR DISTRIBUTION AND NUMBER OF CASCADE NUCLEONS EMITTED BY NUCLEI DURING INTERACTION WITH 660-MeV PROTONS [UGLOVYE RASPREDELENIYA I CHISLO KASKADNYKH NUKLONOV, ISPUSKAEMYKH YADRAMI PRI VZAIMODEISTVII S PROTONAMI S ENERGIEI 660-MeV]

V. A. Kon'shin, E. S. Matusevich, and V. I. Regushevskii [1966] 12 p refs in RUSSIAN
(FEI-28)

The theory of nuclear reactions at energies of several hundreds of Mev is based on Heisenberg's concept of the interaction of fast particles with nuclei as a series of successive collisions with the nucleons in the nucleus and release of the excitation of the residual nucleus by the evaporation of the nucleons, corresponding to the "fast" and "slow" stages of the interaction, respectively. The angular distribution and the number of such cascade nucleons emitted by C, Al, Ni, Cu, Cd, Pb, and U target nuclei were determined for proton beams, the energies of which determined on the basis of the ^{24}Na activity from the $^{27}Al(p,3pn)^{24}Na$ reaction and from ^{209}Bi fission. The angular distribution of the energy of the cascade nucleons was calculated from the energy distribution data of secondary nucleons. It was found that the lighter the nucleus, the more marked is the anisotropy in the angular distribution of secondary nucleons because with increasing mass number of the target nucleus the incident proton is subjected to a larger number of collisions inside the nucleus. The experimental data of the number of cascade nucleons agrees with theoretical predictions for nuclei lighter than Cu; a 1.5-fold divergence was noted for the heavier nuclei. NSA

N66-33932# Brookhaven National Lab., Upton, N. Y.

ANALOGUE STATES OBSERVED VIA DELAYED PROTON EMISSION

R. Mc Pherson 1966 12 p refs Presented at the Am. Phys. Soc., Conf. on Isobaric Spin, Tallahassee
(Contract AT(30-2)-GEN-16)
(CONF-660306-7; BNL-10196) CFSTI: HC $1.00/MF $0.50

A discussion is presented on the observation of proton emission following super-allowed beta decay which allows easy identification on the analog states of the beta-decay daughters. A level diagram illustrating superallowed beta decay of the most neutron deficient member of a T=3/2 multiplet followed by T forbidden proton emission is presented. The proton spectra following ^{25}Si beta decay is discussed. NSA

N66-33942# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

GAMMA RAYS FROM INELASTIC SCATTERING OF 14.1 MeV NEUTRONS ON C-12 AND O-16

T. Kozlowski, W. Kusch, and J. Wojtkowska Sep. 1965 10 p refs
(INR-661/IA/PL)

The gamma spectra from neutron inelastic scattering by ^{12}C and ^{16}O at 14.1 Mev were measured and the angular distributions of the 4.43- and 6.14-Mev gamma rays from ^{12}C and ^{16}O, respectively, were determined. NSA

N66-33945# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

SCATTERING OF TWO PLANE ELECTROMAGNETIC WAVES IN A NONLINEAR ELECTRODYNAMICS OF BORN–INFELD [RASSEYANIE DVUKH PLOSKIKH ELEKTROMAGNITNYKH VOLN V NELINENOI ELEKTRODINAMIKE BORNA–INFEL'DA]

B. M. Barbashov and N. A. Chernikov [1966] 14 p refs In RUSSIAN

((JINR-P-2642)

The scattering problem of two plane waves in classical electrodynamics of Born–Infeld is solved exactly. It turned out that the shape and direction of plane waves after scattering do not change. The wave phase merely changes by a magnitude which is equal to the product of its frequency by the momentum of the incident wave. It is shown that in the interaction region the solution becomes a many-valued function when the electromagnetic field exceeds a certain quantity which plays the role of an absolute scale of the field.

Author (NSA)

N66-33950# Atomic Energy Centre, Dacca (Pakistan).

SCATTERING OF 21- TO 24- MeV ALPHA PARTICLES BY NE

H. M. Sen Gupta and A. H. Khan Mar. 1966 9 p refs

(AECD/EP-10)

Nuclear emulsion techniques were used to study the scattering of α-particles by Ne. Elastic angular distributions were obtained at 20.9, 22.6, and 24.0 MeV over the cm angles 17° to 170° and at 21.4, 21.8, 22.9, and 23.3 MeV over 136° to 170° and inelastic scattering leading to the 1st excited state in ^{20}Ne at 20.9, 22.6, and 24.0 MeV over 17° to 165° cms. Both elastic and inelastic angular distributions show strong diffraction oscillations. Author

N66-33987# Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorentwicklung.

SOME METHODS FOR THE EXPERIMENTAL DETERMINATION OF THE FAST FISSION FACTOR OF BERYLLIUM METAL AND BERYLLIUM OXIDE [UEBER EINIGE METHODEN ZUR EXPERIMENTELLEN BESTIMMUNG DES SCHNELLSPALTFAKTORS VON BERYLLIUMMETALL UND BERYLLIUMOXYD]

Norbert Kirch, Paul. H. Heckmann, and Rudolf Hecker Nov. 1965 29 p refs In GERMAN

(JUL-337-RG)

The methods devised for the experimental determination of the fast fission factor for beryllium and beryllium oxide were described. The methods described are: manganese sulfate activation using reactor thermal neutrons, measurement of the fast fission factor using a cadmium charged liquid scintillator tank, the measurement of the fast fission factor using a californium source, and measurement on pulsed neutron generators. The technique planned for each method is described in some detail. NSA

N66-33988# RAND Corp., Santa Monica, Calif.

A RE-EXAMINATION OF FALLOUT MODELS

R. R. Rapp Feb. 1966 52 p refs

(Contract AT(04-3)-414)

(RM-4910-TAB) CFSTI: HC $3.00/MF $0.50

The steps necessary to produce an operational fallout model are reviewed. Each facet of the problem is discussed, the attendant difficulties pointed out, and the possible compromises suggested. A comparison of recent fallout models was attempted so that the strengths and weaknesses of each can be assessed. Finally, a suggested program for the development of a flexible computer model is made. Such a model could provide a means for examining the variation in prediction as a function of the variation in the input. Author (NSA)

N66-33991# California Univ., Livermore. Lawrence Radiation Lab.

PREDICTION OF TRANSPORT PROPERTIES OF DENSE GASES AND LIQUIDS

B. J. Alder 11 May 1966 30 p refs

(Contract W-7405-ENG-48)

(UCRL-14891-T) CFSTI: HC $2.00/MF $0.50

An accurate and simple theory of transport properties was developed on the basis of the van der Waals concept of a dense fluid. It was shown that calculated values for the transport coefficients of the rare gases at temperatures and densities greater than the respective critical ones agree to within about 10% with the experimental results in both absolute value and temperature dependence, without invoking an activation barrier. In this a priori theory, the cross section, that is the hard sphere diameter, is determined as a function of temperature from the available equilibrium data, within the framework of the van der Vaals theory. Evidence in favor of the van der Waals model and against the activation model was also found in a study of the free path distribution by molecular dynamics computer calculations. This evidence consists of a monotonic free path distribution without a peak near an intermolecular distance at all densities and temperatures for square-well molecules. Furthermore, the free path distribution as well as the radial distribution function are nearly temperature independent at a given density. Finally there were found to be more hard core encounters than sofe collisions even at liquid densities and low temperatures. Author (NSA)

N66-33992# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

ON THE THEORY OF COULOMB INTERACTION [K TEORII KULONOVSKOGO VZAIMODEISTVIYA]

I. I. Tugov 1966 22 p refs In RUSSIAN Submitted for Publication

(JINR-P-2638)

A differential equation in the momentum space was obtained for a many-dimensional Coulomb problem. An equivalence is shown of this equation to the wave equation in a space of constant curvature $K>0$ for a discrete spectrum $E<0$ and $K<0$ for scattering in a field of attraction and in a field of repulsion. Solving Killing's equations gives generators of the symmetry group of the equation. Possible sets of quantum numbers are investigated. An explicit form of diagonal operators is presented and normalized systems of eigenfunctions of the discrete and continuous spectra were constructed for a number of coordinate systems in the three-dimensional case. When scattering in a field of attraction and in a repulsion field the wave functions are infinite equivalent respresentations of the Lorentz groups belonging to the principal series of unitary representations. Author (NSA)

N66-33993# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.

NEW ISOTOPES ^{141}Sm AND ^{140}Sm [NOVYE IZOTOPY ^{141}Sm I ^{140}Sm]

E. Kherrmann, G. Pfrepper, and D. Khristov 1966 12 p refs In RUSSIAN Submitted for Publication

(JINR-P-2647)

New isotopes of ^{141}Sm and ^{140}Sm were found in the spallation products of erbium bombarded with 660-MeV protons. Their half lifes are (22.5±1.4) min and (13.7±0.8) min, respectively. The existence of these isotopes was proved by means of repeated chemical isolation of ^{141}Pm, ^{141}Nd and ^{140}Nd from samarium. The chemical separation was performed by the extraction-chromatographic method with HDEHP fixed on silicagel, as well as by the Szilard–Chalmers reaction in phthalocyanine complex of samarium. Author (NSA)

N66-33994# Atomic Weapons Research Establishment, Aldermaston (England).
AN INVESTIGATION INTO THE PRODUCTION OF NUCLEAR-COMPENSATED SILICON FOR USE IN NUCLEAR PARTICLE SPECTROMETERS
E. M. Gunnersen and R. Ellis May 1966 29 p refs
(AWRE-O-24/66) HMSO: 4s 6d

An experiment is described to irradiate high resistivity p-type silicon with thermal neutrons to obtain near intrinsic silicon with 10–50 μs minotirty carier lifetime at room temperature. Author (NSA)

N66-33995# Japan Atomic Energy Research Inst., Tokyo.
FAST NEUTRON SPECTRUM AND GROUP CONSTANT CODE 7044 UGMG
Satoru Katsuragi, Kinichi Moriguchi, and Yasushi Kuge Mar. 1966 28 p refs In JAPANESE; ENGLISH summary
(JAERI-1104)

The fast neutron spectrum and cross section calculating code for the IBM 7044 digital computer was developed, which is a modified version of the fast neutron spectrum code, MUFT. 54-group microscopic cross sections for up to 65 nuclides can be stored in a tape. Fast neutron spectra are calculated by P-1 or B-1 approximation. Slowing down of two light nuclides can be treated by either Selengut–Goertzel or Greuling–Goertzel approximation, and the rest (heavy nuclides) by either age or consistent age approximation. The heterogeneity effect on the resonance escape probability can be taken into account. The Doppler effect on the resonance absorption can be incorporated in the code. A neutron balance is maintained in the calculation, including inelastic scattering. Few-group constants and the cross sections of specified nuclides are listed as the output data. A separate input program is available for modification of the multigroup cross section tape. The execution time per case is about two minutes. Author (NSA)

N66-33997# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Problems
γ-RAY SPECTRUM OF $Hf^{172}+Lu^{172}$ [SPEKTR γ-LUCHEI $Hf^{172}+Lu^{172}$]
Ya. Vrzal, B. S. Dzhelepov, Ya. Liptak, Ya. Urbanets, and S. A. Shestopalova 1966 12 p refs In RUSSIAN
(JINR-P-2651)

Measurements were made of γ-rays from the radioactive decay of the $^{172}Hf+^{172}Lu$ mixture by means of a coaxial Ge(Li) detector with a sensitive volume of about 5 cm^2. Relative intensities of γ-transitions of ^{172}Lu were determined for the energy range 50 to 2100 keV on the basis of these measurements. Author (NSA)

N66-34001# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ELEMENTARY PARTICLES OF MAXIMUM LARGE MASSES (QUARKS, MAXIMONS)
M. A. Markov 1966 19 p refs Submitted for Publication
(JINR-E-2644)

In field theory (both in quantum and classical regions) it is possible, taking into account the gravitational field, to derive some expressions for the characteristic masses:

$$m_0 = \left(\frac{\hbar c}{\kappa}\right)^{1/2}, m_1 = \frac{e}{\sqrt{\kappa}}$$

An attempt is made to consider these masses as possible maximum values of the elementary particles masses (maximons). It is note-worthy that only for these mass values there arises a peculiar mechanism (gravitational collapse of small masses) which allows to construct resulting systems of arbitrarily small masses out of maximons. The properties of these particles and their possible relation to quarks are discussed. Author (NSA)

N66-34002# California Univ., Livermore. Lawrence Radiation Lab.
EFFECT OF $^3S_1$-$^3D_1$ COUPLING ON THE $^3D_1$ PHASE SHIFT OVER THE 0 TO 320 MeV ENERGY RANGE
Ronald Bryan Apr. 1966 11 p refs
(Contract W-7405-ENG-48)
(UCRL-14885-T) CFSTI: HC $1.00/MF $0.50

The Schroedinger equation and a phenomenological potential was used to estimate the effect of $^3S_1-^3D_1$ coupling on the $^3D_1$ phase shift over the 0 MeV to 320-MeV energy range. NSA

N66-34004# Oak Ridge National Lab., Tenn.
DIRECT SOLUTION OF LANE EQUATION AND THE ANALOGUE STATE RESONANCE IN (p,p) PROCESS
Taro Tamura [1965] 8 p refs Presented at the Am. Phys. Soc. Conf. on Isobaric Spin, Tallahassee, Fla.
(Contract W-7405-ENG-26)
(ORNL-P-2074; Conf-660306-6) CFSTI: HC $1.00/MF $0.50

In order to explain the peaks in the spectra of neutrons from (p,n) reactions, Lane introduced a new term of the form U_1 (t·T), into the usual optical model potential. If this term is considered explicitly in an optical model calculation, it gives rise to a set of coupled equations between the proton and neutron channels. Because of the coupling between the (p) and (n) channels, this resonance is reflected into the (p) channel and a narrow resonance is expected to occur in the (p,p), (p,n) and other reactions. With a reasonable set of optical model parameters, it is shown that such resonances are indeed predicted at the right energies and that the excitation functions thus derived are in good agreement with experiment. NSA

N66-34005# European Organization for Nuclear Research, Geneva (Switzerland).
DETERMINATION OF PARTICLE MOMENTA IN SPARK CHAMBER AND COUNTER EXPERIMENTS
L. Griffiths, C. R. Symons, and B. Zacharov 21 Apr. 1966 45 p refs
(CERN-66-17)

A generalized, iterative, least squares method of fitting trajectories and determining momenta in spark chamber experiments was developed and tested successfully using a wide variety of experimental data. The specification of the field of the magnet used in the momenta determination was also investigated with the aid of various models and also by employing a detailed measured mesh of field values. NSA

N66-34021# Illinois Univ., Urbana. Dept. of Physics.
A SIMPLE RELATIVISTIC CALCULATION OF THE ELECTROMAGNETIC FORM FACTORS OF THE DEUTERON
Klaus Dietz and Melvin Month [1966] 46 p refs
(Contract Nonr-1834(05))
(AD-633951) CFSTI: HC $2.00/MF $0.50

A simple method of extracting anomalous singularities from the electromagnetic vertex function of bound states is proposed. The method was applied to the electromagnetic form factor of the deuteron and its relevance was proven by a thorough comparison with the experimental data. Author (TAB)

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

25

N66-32700# Library of Congress, Washington, D. C. Aerospace Technology Div.

THE POSSIBILITY OF LASER ACTION IN A RAPIDLY COOLED, HIGHLY IONIZED PLASMA

Charles Shishkevish *In its* Foreign Sci. Bull., Vol. 2, No. 6 Jun. 1966 p 1-9 refs (See N66-32699 19-34)

Summary: It is shown that sudden cooling of the free electrons of a highly ionized dense plasma should result in a population inversion in levels near the continuum limit. Recombination of protons and electrons in such a nonequilibrium plasma placed between two mirrors should give rise to stimulated emission on a series of lines in the ultraviolet, visible, and infrared spectral regions. It is estimated that rapid cooling of a hydrogen plasma with an electron concentration between 10^{14} and 10^{16} cm^{-3} from an effective temperature of 20,000 to 1000°K during a period of 10^{-7}-10^{-8} sec would be sufficient for laser action. Several methods for attaining such rapid cooling are proposed and analyzed. Author

N66-32784*# RCA Victor Co., Ltd., Montreal (Quebec). Research Lab.

APPENDIX: SOME SPECTROSCOPIC OBSERVATIONS OF THE INTERACTION BETWEEN A PLASMA WIND AND A DIPOLE MAGNETIC FIELD

J. A. Nilson and R. A. Crane Feb. 1966 20 p refs

(Contract NASw-1088)

(NASA-CR-76879) CFSTI: HC $1.00/MF $0.50 CSCL 20I

Simulated solar wind–magnetosphere turbulences were studied spectroscopically and by automatic photography through seeded plasma interactions with magnetic dipole fields. The integrated photographs of the produced bright crescent-shaped region of luminosity—apparent only for a few tens of microseconds—showed a form similar to that of Van Allen belts. To the left of this phenomenon was the stand-off boundary region where the pressure of the plasma equaled the magnetic pressure. In some photographs a polar blob was observed above and windward of the poles that was not visible in the spectra. G.G.

N66-32822# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

ELECTRICAL PARAMETERS OF THE DC MHD GENERATOR WITH VARIOUS ELECTRICAL CONNECTIONS OF ELECTRODES. PART II: TWO-DIMENSIONAL ANALYSIS [PARAMETRY ELEKTRYCZNE GENERATORA MAGNETOHYDRODYNAMICZNEGO PRZY ROZNYCH ELEKTRYCZNYCH POLACZENIACH ELEKTROD. CZESC II: ANALIZA DWUWYMIAROWA]

Zdzislaw N. Celinski Máy 1965 202 p in POLISH; ENGLISH summary

(INR-654/XVIII/PP)

N66-32834# Commissariate a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.

STUDY OF THE PLASMA COLUMN IN HOLLOW-ELECTRODE ARC [ETUDE DE LA COLONNE DE PLASMA DANS UN ARC A ELECTRODES CREUSES]

Renato Cano, Mario Mattioli, and Bruno Zanfagna Jan. 1966 88 p refs In FRENCH

(CEA-R-2935; EUR-2645.f)

A steady state hollow electrode arc was built. The density of the plasma column obtained varies between 1.5 10^{13} cm^{-3} and 8.10^{14} cm^{-3} when the argon feed rate is varied from 0.2 and 30 l/h S.T.P. and the corresponding values of the electron temperature vary from at least 15 to 1 ev. Three diagnostic methods were utilized: electrostatic probes, far-infrared emission (wave length between 10 and 0.1 mm) and microwave techniques utilizing either the transmitted or the reflected wave. The results obtained are described in detail and compared. Limits of utilization of the different techniques are given. Author (NSA)

N66-32879# Stanford Univ., Calif. Inst. for Plasma Research.

STUDIES OF PLASMA OSCILLATIONS Quarterly Status Report No. 25, 1 Dec. 1965-28 Feb. 1966

F. W. Crawford Mar. 1966 40 p refs

(Contract AT(04-3)-326)

(SU-IPR-59) CFSTI: HC $2.00/MF $0.50

Further experimental and theoretical research is reported on each of the following four projects: ion wave propagation and positive column instabilities; electron beam probing of plasmas; beam/plasma interactions; and positive column resonances and propagation. A steady-state theory and low-frequency perturbations leading to wave propagation and instabilities in a positive column were investigated in the absence of a magnetic field. NSA

N66-32893# Stanford Univ., Calif. Stanford Linear Accelerator Center.

MEAN ENERGIES AND DRIFT VELOCITIES OF ELECTRONS IN NITROGEN, ARGON AND XENON, DETERMINED BY IMAGE INTENSIFIER PHOTOGRAPHS OF ELECTRON AVALANCHES

K. H. Wagner [1964] 31 p refs Transl. into ENGLISH from Z. Phys. (Berlin), v. 178, 1964 p 64-81

(SLAC-TRANS-19)

Local and temporal development of electron avalanches in a pulsed discharge gap (d=3.00 cm) are investigated in N_2, Ar, Xe and in mixtures of N_2 and CH_4 by simultaneously applying high-gain image intensifier- and photomultiplier techniques. Electron-drift velocities are obtained from time-of-flight and path-of-flight measurements in these gases. The mean energy of agitation of the electrons is derived both from electron mobility and avalanche image trace profile (diffusion broadening). Author (NSA)

N66-32966# International Atomic Energy Agency, Vienna (Austria).

PLASMA PHYSICS

1965 679 p refs Lectures Presented at the Seminar on Plasma Phys., Trieste, Italy, 5-31 Oct. 1964

CFSTI: HC $9.79/MF $3.25

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N66-32967# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratorio Gas Ionizzati

PLASMA DIAGNOSTICS BASED ON REFRACTIVITY

U. Ascoli-Bartoli *In* Intern. Atomic Energy Agency Plasma Phys. 1965 p 287–321 refs (See N66-32966 19-25) CFSTI: HC $9.79/MF $3.25

The idea of using a beam of light as a plasma probe occurs when the need arises to diagnose a discharge without introducing large perturbations. In order to classify the phenomena involved in the diagnosis, a distinction must be made between absorption, transmission, and reflection. This discussion is limited to the refractivity and implies that the spatial density distribution of the plasma does not undergo abrupt variations within distances of many light wave lengths. Equations are given in support of the conclusion that the refractivity of a plasma is the result of the following contributions; electron gas, ion gas, excited or unexcited atoms, molecules, and the magnetic field. In planning an experiment based on refractivity, the relative importance of these contributions must be evaluated; for example, in a high temperature plasma in hydrogen or deuterium, the electron gas contribution predominates. Some methods and techniques in refractivity diagnosis are reviewed including interferometric measurements, the Schlieren method, and the shadow graph. Additionally the limits to these methods are discussed. H.S.W

N66-32968# Boeing Scientific Research Labs., Seattle Wash.

SOME RELATED PHENOMENA IN PLASMAS, IN SOLIDS AND IN GASES

J. E. Drummond *In* Intern. Atomic Energy Agency Plasma Phys. 1965 p 323–340 refs (See N66-32966 19-25) CFSTI: HC $9.79/MF $3.25

Two examples of the development of related phenomena in plasmas in gases and in solids were examined. One concerns the discovery of electrical discharges in gases by Lehnert, and the other concerns the discovery of electrical conduction in a semiconductor. Additional examples of phenomena in electron-hole plasmas that have bearing on fusion research, including the pinch effect, are briefly discussed. It is stated that it is of interest to note that these seemingly unrelated discoveries can be used to theoretically correlate phenomena in small solids at 4°K with the phenomena occurring in sun spots at millions of degrees. H.S.W.

N66-32969# Imperial Coll. of Science and Technology, Londor (England).

PLASMA THEORY AND OBSERVATIONS IN SPACE

J. W. Dungey *In* Intern. Atomic Energy Agency Plasma Phys. 1965 p 341–347 refs (See N66-32966 19-25) CFSTI: HC $9.79/MF $3.25

The discoveries and measurements made by Explorer XII, Mariner II, and Imp are assessed in terms of the importance of these discoveries in defining the magnetosphere. Theoretical predictions are compared with actual observation; for example the discovery and velocity of the solar wind. It is stated that the magnetic field is relatively easy to measure, however, measurements of the electric field are more difficult. H.S.W

N66-32972# California Univ., Livermore. Lawrence Radiation Lab.

TOROIDAL MAGNETIC FIELD CONFIGURATIONS AND FINITE RESISTIVITY

H. P. Furth *In* Intern. Atomic Energy Agency Plasma Phys. 1965 p 391–409 refs (See N66-32966 19-25) CFSTI: HC $9.79/MF $3.25

The confinement of low-β plasma in closed vacuum magnetic field configurations is discussed, in relation to the finite resistivity hydromagnetic stability problem. The phenomena of shear stabilization are considered, and various interpretations are presented. Some $\int dl/B$ stable configurations are examined, and treatments based on periodic multipole solutions, stagnation point solutions, and floating ring solutions are detailed. Equations are derived for estimating the low-β stability properties of the configuration. It is assumed that β is very small; the finite resistivity affects allowing for the presence of shear are also analyzed. It was concluded that the results document the relative utility of $\int dl/B$ and shear stabilization. M.G.J.

N66-32973# California Univ., Livermore. Lawrence Radiation Lab.

EXPERIMENTS IN TOROIDAL PLASMA CONFINEMENT

H. P. Furth *In* Intern. Atomic Energy Agency Plasma Phys. 1965 p 411–420 refs (See N66-32966 19-25) CFSTI: HC $9.79/MF $3.25

The nature of the plasma stability problem is examined, and the instabilities of closed configurations are classified according to the energy reservoirs that derive them. It is pointed out that the actual nonlinear results of instability are generally difficult to diagnose and to trace back to known linear modes. Toroidal confinement research is reviewed, and details are given on experiments with the toroidal hard core configuration or levitron. It is pointed out that if toroidal confinement experiments are to attain significance, a nondisruptive method of plasma generation will be required, and

an allowance made for flexible configurational changes to test the stability theory. Two promising methods for highly quiescent plasma generation are noted: electron–cyclotron heating, and injection of a low-energy neutral atom beam. M.G.J.

N66-32974# Academy of Sciences (USSR), Moscow. Kurchatov Atomic Energy Inst.

MIRROR TRAPS

M. S. Ioffe *In* Intern. Atomic Energy Agency Plasma Phys. 1965 p 421–448 (See N66-32966 19-25) CFSTI: HC $9.79/MF $3.25

Magnetic mirror configurations for plasma confinement are discussed, and the effect of the magnetic field on the confining properties of the magnetic mirror is considered. The confining properties of mirror traps are surveyed from the viewpoint of the kinematics of the individual charged particles and pair collisions. Plasma instabilities in mirror traps are considered, and the main characteristics are tabulated for various experimental devices which vary in their geometrical dimensions, magnetic field strength, plasma formation techniques, and plasma parameters. Methods of injecting high temperature plasma into traps are reviewed, and the results of several hybrid magnetic field experiments are presented. Details are also given on plasma lifetime measurements covering plasma lifetime and stabilizing field dependence; plasma lifetime and pressure dependence; stabilizing field effect on the plasma density fluctuations; and plasma density distribution along the radius of the trap. M.G.J.

N66-32975# United Kingdom Atomic Energy Authority, Culham (England).

PLASMA CONFINEMENT IN MAGNETIC WELLS

J. B. Taylor *In* Intern. Atomic Energy Agency Plasma Phys. 1965 p 449–481 refs (See N66-32966 19-25) CFSTI: HC $9.79/MF $3.25

Plasma confinement and stability in magnetic wells, hybrid traps, or minimum-B fields are considered, and it is pointed out that these special magnetic fields combine the adiabatic containment properties of the simple mirror field with the stability of the cusp field. A special class of equilibria is discussed in which only two properties are used for containment and stability: (1) The field is nowhere zero, so that adiabatic containment is possible. (2) The magnetic field strength increases outward. General equilibria in magnetic wells are examined, in which the guiding center drift description of a low-β plasma is used. Stability at finite pressure is also considered. M.G.J.

N66-32976# General Dynamics Corp., San Diego, Calif. General Atomic Div.

MICROINSTABILITIES

M. N. Rosenbluth *In* Intern. Atomic Energy Agency Plasma Phys. 1965 p 485–513 refs (See N66-32966 19-25) CFSTI: HC $9.79/MF $3.25

The mechanism and rate at which a collisionless confined system would proceed towards equilibrium are discussed from the standpoint of hydrodynamic instabilities and microinstabilities. A specific calculation is presented in which instability feeds on the anisotropy of the distribution function, and a case is considered in which the ion distribution function is characterized by a loss cone such as would be brought about by magnetic mirrors. The dispersion relation for microinstabilities of inhomogeneous plasma is examined, with attention focused on the effects of a slight inhomogeneity on the plasma stability. Examples are included in which the general dispersion relation equation is applied to special cases of microinstabilities of homogeneous plasmas. M.G.J.

N66-32977# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France).

PLASMA STABILITY

M. Vuillemin *In* Intern. Atomic Energy Agency Plasma Phys. 1965 p 515–525 refs (See N66-32966 19-25) CFSTI: HC $9.79/MF $3.25

The energy principles of classical magnetohydrodynamics has been successfully used in investigations of inhomogeneous plasmas in static equilibrium, however, this method is not sufficient for inhomogeneous plasmas, which are not in static equilibrium. Instead of handling these problems in a general way, techniques for each case must be sought. As a guide for developing these techniques, Low's theorem is examined, and the instabilities of a plane current sheet are treated. H.S.W.

N66-32978# General Dynamics Corp., San Diego, Calif. General Atomic Div.

QUASI-LINEAR THEORY OF PLASMA TURBULENCE

W. E. Drummond *In* Intern. Atomic Energy Agency Plasma Phys. 1965 p 527–541 refs (See N66-32966 19-25) CFSTI: HC $9.79/MF $3.25

The dynamics of a low β, collisionless, unstable plasma are examined, from the time of the onset of the instability to the final quiescent, equilibrium state. The time development of this process can be roughly broken into four phases. During the first phase the linearized theory applies and the unstable waves grow exponentially. In the second phase the so-called quasi-linear theory applies and the background particle distribution diffuses in such a way as to bring the growth rate of the unstable waves to zero, leaving a quasi-stationary spectrum of waves. In the third phase the waves in the quasi-stationary spectrum interact in such a way as to distort the spectrum but to keep the energy in the spectrum roughly constant. In the fourth phase the waves interact to produce virtual waves which in turn lose energy to the bulk of the particles by Landau damping. The first two phases of this process can be fairly well separated in time; however phase III and phase IV occur roughly simultaneously. Author

N66-32979# Academy of Sciences (USSR), Moscow. Nuclear Energy Inst.

PLASMA TURBULENCE—GENERAL TOPICS

B. B. Kadomtsev *In* Intern. Atomic Energy Agency Plasma Phys. 1965 p 543–554 (See N66-32966 19-25) CFSTI: HC $9.79/MF $3.25

In order to verify the presence of turbulent motion in a plasma it is stated that the fluction of some microscopic parameters in plasmas must be measured. If two electric probes are introduced in a plasma, the fluctuation of the electric potential of these probes may be determined, and the correlation function of the electric fields in two points at different moments of time may be measured. By measuring the correlation function, it can be established whether the turbulence is strong or weak. A theory for studying weak turbulence of a plasma is surveyed, and cases when strong turbulence is present are considered. H.S.W.

N66-32980# Akademiya Navk SSSR, Novosibirsk. Institut Yadernoi Fiziki.

LANDAU DAMPING AND FINITE RESISTIVITY INSTABILITY IN PLASMAS

R. Z. Sagdeev *In* Intern. Atomic Energy Agency Plasma Phys. 1965 p 555–566 refs (See N66-32966 19-25) CFSTI: HC $9.79/MF $3.25

Anomalous damping in collision-free plasmas of finite amplitude disturbances is considered. Landau damping is defined and the distortion of the distribution function is included in the investigation. It is shown that nonlinear wave damping takes place in the distribution of resonant particles responsible for damping. Additionally the connection between finite resistivity

instability and Bohm diffusion is examined in relation to the finite resistivity instability in a plasma column situated in a strong magnetic field with straight lines of force. H.S.W.

N66-32981# AVCO-Everett Research Lab., Everett, Mass.
SHOCK WAVES IN COLLISION FREE PLASMAS
H. E. Petschek *In* Intern. Atomic Energy Agency Plasma Phys. 1965 p 567–576 refs (See N66-32966 19-25) CFSTI: HC $9.79/MF $3.25

The mechanisms by which the directed flow of energy ahead of a shock wave is converted to random energy behind the shock wave are discussed. In the collision dominated case, the isentropic theory of characteristics leads to the conclusion that a pressure pulse steepens. In the collision free case, however, as the gradients increase the steepening process is not inhibited directly by dissipative effects but rather by non-dissipative changes in the dispersion relation of small amplitude waves. To demonstrate some of the possible mechanisms which may occur, an analogy is drawn between collision free plasma shocks and hydraulic lumps in water. Plasma wave trains are discussed and it is stated that with any small dissipation a nonlinear wave train develops which then gradually damps. The damping in the plasma case may be attributed to the remaining collisional effects, or Landau damping. At some shock strength however, instabilities are expected which lead to a turbulent shock. A model suggested for a fully turbulent shock propagating perpendicular to the magnetic field into a zero temperature plasma is examined, related formal equations are reviewed, and the extent to which a possible solution can be suggested is indicated. H.S.W.

N66-32982# Brussels Univ. (Belgium).
ADVANCED KINETIC THEORY
R. Balescu *In* Intern. Atomic Energy Agency Plasma Phys. 1965 p 577–594 refs (See N66-32966 19-25) CFSTI: HC $9.79/MF $3.25

A model of a plasma is considered, consisting of N particles of charge e, mass m, enclosed in a cubic box of volume Ω. The total charge is neutralized by a continuous background of opposite charge. The Hamiltonian of the system is given, and the methods used in the solution of the Liouville equation, the kinetic equation of the problem, are outlined. H.S.W.

N66-32983# Manchester Univ. (England). Dept. of Theoretical Physics.
TURBULENCE IN HYDRODYNAMICS AND PLASMA PHYSICS
S. F. Edwards *In* Intern. Atomic Energy Agency Plasma Phys. 1965 p 595–623 refs (See N66-32966 19-25) CFSTI: HC $9.79/MF $3.25

Equations are derived which support a theory developed to investigate the phenomenon of turbulence in incompressible hydrodynamics. The model proposed is extended to include a discussion of MHD turbulence with and without magnetic fields. The ideas developed from these considerations are then used as a basis for investigating the kinetic theory in a plasma using the Lagrangian method. H.S.W.

N66-32984# Akademiya Nauk SSSR, Novosibirsk. Institut Yadernoi Fiziki.
ASYMPTOTIC METHODS IN THE HYDRODYNAMIC THEORY OF STABILITY
R. Z. Sagdeev *In* Intern. Atomic Energy Agency Plasma Phys. 1965 p 625–643 refs (See N66-32966 19-25) CFSTI: HC $9.79/MF $3.25

Physical considerations are discussed for an equation which describes the stability of a slightly non-uniform plasma, and it is shown that there is an asymptotic approach to the analysis of the equation. Solutions are given for both the strong and the weak cases. H.S.W.

N66-33038# Royal Aircraft Establishment, Farnborough (England).
GENERAL CHARACTERISTICS OF ELECTRIC ARCS
O. I. Yasiko May 1966 15 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (USSR), v. 7, no. 12 (1964) p 112–116 (RAE-LIB-TRANS-1165) CFSTI: HC $1.00/MF $0.50

Characteristics of electric arcs may be correlated by parametric equations derived from energy relations. Equations are obtained for strong current arcs with blowing, assuming heat transfer by turbulent conduction. Equations are also derived for stabilized arcs. It is shown that experimental data may be correlated by dimensional groups corresponding to the obtained parameters provided that physical properties are constant. Author

N66-33131# United Kingdom Atomic Energy Authority, Culham (England). Research Group.
CURRENT INDUCED PUMP-OUT
E. S. Hotston and D. J. H. Wort 1966 37 p refs
(CLM-R55) HMSO: 4s 6d

Afterglow plasmas in hydrogen and deuterium produced in a toroidal device were shown to be quiescent. A typical afterglow had an electron density of 4×10^{13} cm^{-3} near the bore center and electron and ion temperatures substantially equal at 3200°K. Near the torus wall the ion temperature fell to approximately half the electron temperature. This plasma was produced in an axial magnetic field of 150–500 gauss, and decayed by classical diffusion and recombination processes with a lifetime of 200 μsec. An instability was induced in this plasma by causing a current of 1–2 A cm^{-2} to flow in it. This instability caused a rapid loss of plasma (pump out), and was outwardly very similar to the pump out induced in the Stellarator. It was found that the criterion for the current required to cause pump out is incorrect, as the seat of the instability lies in the tenuous post-pump out rather than the pre-pump out plasma. The correct criterion, given by Jackson, was obeyed within a factor of five. There is no difficulty with the apparent absence of ion Landau damping which Motley required for his drift criterion to be valid. The instability, after starting in the low density plasma near the inner wall of the torus, propagated outward, creating a low density plasma suitable for its own maintenance as it proceeded. Author

N66-33132# United Kingdom Atomic Energy Authority, Culham (England). Research Group.
A COMPUTER PROGRAM FOR THE DESIGN OF HIGH PERVEANCE ION SOURCES
D. G. Bate Jan. 1966 47 p refs
(CLM-R53) HMSO: 6s

The report describes the use of digital computer program to calculate ion trajectories in the extraction region of high perveance plasma ion sources. The effects of electric fields, magnetic fields, and space charge are included in the calculations; and the plasma boundary shape and position can be determined for plasma whose density distribution is known. Examples are given of the types of problems which have been studied by this method. Complete instructions for the use of the program, illustrated by the input and output of a sample problem, are presented in an appendix. Author

N66-33220# Columbia Univ., New York. Plasma Lab.
IONIZING SHOCK STUDIES IN AN ELECTROMAGNETICALLY DRIVEN SHOCK TUBE
Bennett Miller Jun. 1965 140 p refs
(Contract AF 49(638)-1254)
(Rept.-19; AD-621990) CFSTI: HC $4.00/MF $1.00

A coaxial electromagnetic shock tube was used to study ionizing shocks propagating through hydrogen. An experiment is described which produced plane switch-on ionizing

shocks. Studies were conducted covering the sub-Alfvenic, trans-Alfvenic and super-Alfvenic regimes. Data is presented that verifies the existence of switch-on fronts in all these regimes, and demonstrates the significant effect of the initial electric field on the shock jump conditions. The results substantiate the theory of normal ionizing shocks developed by Taussig. A simple physical criterion is employed to choose from among the several theoretically predicted ionizing waves propagating at a given speed. This criterion has strong intuitive support and results in a consistent picture of ionizing shock propagation that is in general agreement without experimental observations. The existence of a small homogeneous plasma sample, behind the ionizing shock wave and before the expansion fan, is demonstrated. Previous failures to find large homogeneous plasma samples are shown to be consistent with the theory of ionizing shock waves.

Author (TAB)

N66-33232# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

THE APPLICATION OF A DIFFERENTIAL INTERFEROMETER TO AN AXIALLY SYMMETRIC ARC HEATED PLASMA

Jimmy D. Lamb (M.S. Thesis) Mar. 1966 142 p refs

(GSP/PH/66-11; AD-633648) CFSTI: HC $4.00/MF $1.00

The refractive index of an atmospheric argon arc-heated plasma was measured with nearly monochromatic 5463 Å light. The measurement was made with a differential interferometer which was compact and easy to set up and use. The basic components of the interferometer are two Wollaston prisms and a concave mirror. One prism separates plane polarized light into two diverging components to provide an optical path separation through the test object space. Optical inhomogeneities in the (plasma) object result in phase shifts between the separated rays. These phase shifts are doubled during the return passage of the rays upon reflection by the concave mirror. A second Wollaston prism, analyzer, and camera lens produce an interference fringe pattern which can be photographically recorded. The plasma induced phase shifts produce deflections of the nominally straight and parallel fringes. These deflections are proportional to the first derivative of the optical path through the plasma. Integration of the deflection curves was performed to yield the optical path shifts relative to air as a function of lateral distance.

Author (TAB)

N66-33253# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Electrophysics.

DIFFRACTION BY A HALF PLANE IN A COMPRESSIBLE HOMOGENEOUS PLASMA

Frank M. Labianca and Leopold B. Felsen 17 Jan. 1966 55 p refs

(Contracts AF 19(628)-2357; Nonr-839(38); ARPA Order 529) (PIBMRI-1304-65; AFCRL-66-72; AD-633653) CFSTI: HC $3.00/MF $0.50

An exact solution, developed by means of the Wiener–Hopf technique, is given for the electromagnetic (optical) and pressure (acoustic) fields generated by a plane wave incident on a perfectly conducting half plane imbedded in a homogeneous, warm plasma. From an asymptotic evaluation by the method of steepest descent, it is found that in addition to reflected optical and acoustic plane waves coupled at the boundary, and to a cylindrically spreading diffraction field appearing to emanate from the edge and penetrating both the illuminated and geometric-optical shadow regions, there exist edge diffraction effects in the form of surface waves and lateral waves. Relevant characteristics of these wave species are described and interpreted in simple physical terms via ray optical techniques. Some numerical data are also given. Although the plasma model is idealized, the results should be useful in predicting wave excitation phenomena to be associated with edge singularities.

Author (TAB)

N66-33256# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

EVOLUTION OF A PLASMA PUFF IN A LONGITUDINAL MAGNETIC FIELD

Samuel J. Moss Jan. 1966 69 p refs

(Contract NOw-62-0604-c)

(TG-808; AD-633626) CFSTI: HC $3.00/MF $0.75

The hydromagnetic model of the evolution of a plasma puff in a B_z field described by Waelbroeck has been used to analyze the characteristics of the plasma produced by the APL conical pinch gun. The analysis is based on fitting loops by the passing plasma. In the cases studied good fits to the signals have been achieved and the characteristic parameters of the plasma found. This analysis applied to plasma generated by the APL theta-pinch gun has not been successful. In the two cases studied, the lack of good fits is attributed to the presence of a sizeable amount of trapped field in the puff which is present along the entire flight path through the B_z field.

Author (TAB)

N66-33263# Illinois Univ., Urbana. Coordinated Science Lab.

INVESTIGATION OF DENSE PLASMA UNDER A STRONG ELECTRIC FIELD

Clifford W. Mendel, Jr. (Ph.D. Thesis) May 1966 80 p refs

(Contract DA-28-043-AMC-00073(E))

(R-289; AD-633593) CFSTI: HC $3.00/MF $0.75

A hydrogen plasma of density $\approx 10^{-16}$ cm^{-3} and electron temperature ≈200 eV was investigated under electric fields of 100 to 500 V/cm. A pinch of pinch ratio ≈3 was found to be hydrodynamically stable for ≈2 μsec, during which the experiment was performed. A sharp burst of runaway electrons of total current of the order of amperes occurred and disappeared shortly after conduction began. Large low frequency oscillations believed to be ion–acoustic oscillations appeared and give rise to very high resistivities in qualitative agreement with recent theories on plasma conductivity. Author (TAB)

N66-33440*# Geophysics Corp. of America, Bedford, Mass.

SPUTTERING ION SOURCE STUDY PROGRAM, SECOND PHASE Final Report, 2 Jan.–15 Nov. 1962

15 Dec. 1962 31 p Prepared for JPL

(Contracts NAS7-100; JPL-950118)

(NASA-CR-77051) CFSTI: HC $2.00/MF $0.50 CSCL 20I

The sputtering ion source for the analysis of solids was thoroughly tested during this period. Valuable experience was gained concerning what improvements could be made to increase the ion yield and diminish the discrimination effects. An interesting feature of the new ion source is that the gaseous background from hydrocarbons and the constituents of the air appear small compared to the intensities of the sputtered ions. The mass spectra are extremely simple and consist of peaks from single ionized atoms. Another unique feature of the ion source as compared to the conventional spark source is its stable operation which permits electrometric recording of the mass spectrum. The ion source appears to be a promising tool for solids analysis and is also applicable to conducting and insulating materials.

R.N.A.

N66-33700*# National Aeronautics and Space Administration, Washington, D. C.

THEORY OF PULSE DISCHARGES IN A LIQUID MEDIUM [K TEORII IMPUL'SNYKH RAZRYADOV V ZHIDKOY SREDE]

V. V. Arsent'yev May 1966 18 p refs Transl. into ENGLISH from Zh. Prik. Mekhan. i Techn. Fiz. (Moscow), no. 5, 1965 p 51–57

(NASA-TT-F-10147) CFSTI: HC $1.00/MF $0.50 CSCL 20I

Certain phenomena occurring during underwater spark discharges were studied. Equations for the energy balance, the number of particles, and the rate of expansion of a channel

were obtained for underwater discharges during the first quarter of a period. It was shown that a steady-state regime of channel expansion and shock-wave motion exists, during which time the characteristic parameters have constant values. These steady-state values were calculated. Author

N66-33768# Institut für Plasmaphysik G.m.b.H., Garching (West Germany).

INTERFEROMETRIC MEASUREMENTS ON ELECTROMAGNETICALLY GENERATED SHOCK WAVES [INTERFEROMETRISCHE UNTERSUCHUNGEN AN ELEKTROMAGNETISCH BESCHLEUNIGTEN STOSS WELLEN]

H. Brinkschulte Dec. 1964 58 p refs In GERMAN; ENGLISH summary

(IPP-3/24) CFSTI: HC $2.50/MF $0.75

The phenomena occurring in an electromagnetic shock tube were investigated using a rotating-mirror camera and a Mach–Zehnder interferometer. The test gas used was hydrogen in the pressure range $2.5<p_0<10$ mmHg. The luminous phenomena detected are identical with the plasma already formed between the electrodes during the discharge. With the interferometer it was possible to show that a nonluminous shock wave is also formed and is reproducible. The shock front is plane and always precedes the luminous front. As the velocity increases the distance between the two fronts decreases. At velocities exceeding 2.5 cm/usec the discharge plasma advances right into the shock front. The discontinuity in the density across the front was also measured. This agrees with the value calculated from the Rankine–Hugoniot equations, if thermal equilibrium is assumed. Since the gas was partially dissociated in the velocity range investigated, it was possible to determine experimentally the refractive index for atomic hydrogen. The shock wave itself runs free and is in an unsteady state. The total time history of the shock wave conforms to the homology theory according to von Weizsacker. Interferometric measurements of both the density drop behind the front and decrease the shock front velocity along the tube support this theory. Author

N66-33787# Lockheed Missiles and Space Co., Palo Alto, Calif.

NONLINEAR PROCESSES IN A ONE-DIMENSIONAL AND ONE-COMPONENT PLASMA

N. A. Khizhniak and A. M. Korsunskii [1965] 10 p refs Transl. into ENGLISH from Vysokochastn. Svoistva Plazmy, Naukova Dumka (Kiev), 1965 p 148–155

General nonlinear solutions are presented for a one dimensional kinetic equation without a collision term. The electron density, the electron flux density, and the energy density are taken to be explicit functions of the self-consistent electric field potential. It is shown in this case that the fundamental plasma characteristics may be constructed within the framework of the hydrodynamic approximation. It is concluded that the solutions permit the investigation of collisionless electron transition from the captured particle domain and their energy distribution to the other plasma electrons. D.T.

N66-33791# Lockheed Missiles and Space Co., Palo Alto, Calif.

DETERMINATION OF THE PLASMA DENSITY AND TEMPERATURE DISTRIBUTION BY RAY REFRACTION AND ATTENUATION

V. L. Sizonenko and K. N. Stepanov [1965] 10 p refs Transl. into ENGLISH from Vysokochastn. Svoistva Plazmy Kiev, Naukova Dumka Press, 1965 p 109–117

The passage of a microwave ray through an inhomogeneous plasma was investigated. It is shown that the plasma density distribution may be determined from the refraction of the ray; and that the plasma electron temperature distribution may be determined by means of attenuation of the mode energy along the ray. D.T.

N66-33793# Lockheed Missiles and Space Co., Palo Alto, Calif.

KINETIC THEORY OF ELECTROMAGNETIC WAVES IN A BOUNDED PLASMA

A. N. Kondratenko [1965] 13 p refs Transl. into ENGLISH from Vysokochastotn. Svoistva Plazmy Kiev, Naukova Dumka Press, 1965 p 71–82

The propagation of electromagnetic waves in a plasma bounded along one axis and unbounded along the other two was investigated. It is noted that in the absence of a magnetic field the waves will be surface waves. A self-consistent system of Maxwellian equations was used to describe the process, and a linearized kinetic equation was used for the deviation of particles, i.e., electrons and ions, from the equilibrium distribution function in which binary particle collisions are neglected. It was found that the damping decrements of surface ion–acoustic waves turn out to be large in a number of cases. The plasma ions introduce a significant, and sometimes fundamental, contribution to the damping. Thus, as the layer thickness diminishes, the phase velocity of the wave is reduced; hence, the ion contribution to the damping is increased, and the electron contribution is decreased. D.T.

N66-33794# Lockheed Missiles and Space Co., Palo Alto, Calif.

ENERGY EXCHANGE BETWEEN HIGH AND LOW-FREQUENCY OSCILLATIONS IN PLASMA

V. D. Fedorchenko, V. I. Muratov, and B. N. Rutkevich [1965] 11 p refs Transl. into ENGLISH from Vysokochastotn. Svoistva Plazmy Kiev, Naukova Dumka Press, 1965 p 118–126

The interaction of the external high frequency field with the low frequency ion oscillations was investigated, using a hollow electron beam in a longitudinal magnetic field. Interaction was observed in the following cases when the frequency of the external signal: (1) did not agree with any of the natural plasma frequencies, (2) agreed with the electron cyclotron frequency, and (3) agreed with the electron plasma frequency. Details are presented for each case, and it is concluded that there is efficient energy transfer from the electron plasma oscillations to the ion oscillations. N.E.N.

N66-33819# General Dynamics Corp., San Diego, Calif. General Atomic Div.

A STUDY OF PLASMA TURBULENCE Final Report, 24 Apr. 1962–19 Sep. 1965

W. E. Drummond and J. H. Malmberg Kirtland AFB, N. Mex., AF Weapons Lab., May 1966 248 p refs

(Contract AF 29(601)-5338; AF 29(601)-6366)

(GA-6776; AFWL-TR-65-190; AD-633974) CFSTI: HC $6.00/MF $1.25

This report summarizes results of a three-year program of experimental and theoretical research to investigate turbulence in collisionless plasmas. The Quasi-linear theory of Plasma turbulence is extended to include the effect of resonant and nonresonant mode-coupling terms. The theory, originally done in the time domain, is applied to the case of spatially growing waves. The generation of electromagnetic radiation at twice the plasma frequency and microwave scattering from plasma turbulence are investigated theoretically. The kinetic theory of unstable plasmas is systematically developed. A measurement of the Landau damping of electrostatic plasma waves is described. The results agree in detail with the predictions of the theory. The growth of unstable plasma waves due to a gentle bump on the velocity distribution function is measured. The termination of the growth, due to nonlinear

effects, (i.e., the diffusion of particles in the velocity distribution function by the electric fields of the wave) is observed. These results are also in quantitative agreement with the theory. this report contains the full text of eighteen scientific papers resulting from this research program. In these papers the above results and other related research are described in detail. Author (TAB)

N66-33885# California Univ., Berkeley. Electronics Lab.
PLASMA RESEARCH Third Quarterly Progress Report, 1 Jul.–30 Sep. 1965
Sep. 1965 42 p Submitted for Publication
(Contract AF 33(615)-1078; AT(11-1)-34)
(TID-22881) CFSTI: HC $2.00/MF $0.50

The hot-electron experiment operated satisfactorily during this period. Effort was concerned with obtaining adequate data to determine the absolute intensity of the synchrotron radiation emitted by the hot-electron plasma. Brief discussions of results are given on the synchrotron radiation measurements, electron cyclotron heating, and plasma diagnostics with a laser. An investigation was made to determine adiabatic compression of a plasma with turbulent heating of ions at the ion-cyclotron frequency by electron beam excitation of ion waves. An *r-f* ion source for an ion-energy analyzer is being developed. Brief discussions are presented on related experimental and theoretical research. NSA

N66-33894# Kernforschungsanlage, Juelich (West Germany). Institut fuer Plasmaphysik.
PRODUCTION OF A HIGH-VELOCITY COLLISIONLESS PLASMA PULSE
W. Bieger and H. Tuczek Oct. 1965 12 p refs Presented at the 7th Intern. Conf. on Phenomena in Ionized Gases, Belgrade, 1965 Submitted for Publication
(JUL-314-PP; CONF-650806-23)

By interaction with a moving inhomogeneous magnetic field, produced by a traveling wave on a special transmission line, plasma is accelerated. If collisions between the ions are negligible in the plasma, pulses with a homogeneous radial density distribution and velocities up to 10^8 cm/sec are observed. The reflection mechanism of the ions by the magnetic field can be described by a free model in good agreement with the measurements. Losses of particles, due to a leakage on the axis of the field and due to scattering are studied by measurements with an ion spectrometer and a microwave interferometer. Author (NSA)

N66-33939# Laboratoire de Recherches sur la Physique Des Plasmas, Lausanne (Switzerland).
STUDY OF AN AXIAL HIGH-FREQUENCY DISCHARGE [ETUDE D'UNE DECHARGE HAUTE FREQUENCE AXIALE]
A. Heym and E. S. Weibel Dec. 1965 20 p refs In FRENCH
(LRP-19/65)

The measurements made on a high-frequency linear discharge fed by a generator giving a 30 Mw for 10 periods at a frequency of 2 MHz were reported. The analysis of the results of the magnetic probe measurements and of photographic measurements taken with a turning mirror channel showed the shock waves and the mass movements in this discharge. The study of the time evolution of the magnetic field profile made it possible to estimate the electron temperature of the plasma. The existence of a negative resistance of the field in the limited shell at certain moments of the period made it possible to interpret the light emitted in the vicinity of the walls as the results of the bombardment of the walls by electrons. The results show that a linear discharge confined by walls in which the initial pressure is 60 or 100μ Hg of hydrogen is present in the form of a ring whose temperature is of the order of 6 ev. The ring surrounds a hot nucleus carrying a small current and is formed by the energy and material contribution of successive shock waves appearing at each semiperiod. The mean velocities measured move in the direction of a compression up to the fourth period, then in the direction of an expansion up to eighth period, and are annulled toward the end of the discharge. The results at 25 μ of Hg do not appear fundamentally different from those at 60 and 100 μ, although the photography does not show the existance of a nucleus. Theoretical limitations made it impossible to make conclusions on the values of the temperature and velocity in this case. Author (NSA)

N66-34019# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
THE GLOW DISCHARGE IN MIXTURES OF He:Ne and He:Xe
Robert Frederick Weber (M.S. Thesis) Mar. 1966 146 p refs
(GSP/PH/66/21; AD-633605) CFSTI: HC $4.00/MF $1.00

The low pressure (3 to 15 mm Hg) glow discharge operating in He, Ne, Xe, and He:Ne and He:Xe mixtures (96:4 to 20:80) was used to study moving striations and the effects of electrophoresis and cataphoresis on the striations and other parameters of the discharge. The experimental work is accompanied by a concise review of positive column theory and moving striations theory for the conditions of the experimental study. The theories of electrophoresis and cataphoresis are also developed. Author (TAB)

N66-34043*# Ohio State Univ. Research Foundation, Columbus. Antenna Lab.
THE SUBSTITUTION OF A SEMI-INFINITE, HOMOGENEOUS DIELECTRIC MEDIUM FOR A PLASMA SLAB
S. Gotkis 30 Apr. 1966 66 p refs *Its* Rept.-1691-19
(Grant NsG-448)
(NASA-CR-77137) CFSTI: HC $3.00/MF $0.75 CSCL 20I

The substitution of a homogeneous, semi-infinite dielectric for a finite plasma slab is studied as a means of simplifying the analyses of the impedance of an aperture antenna radiating into an inhomogeneous plasma medium. Such a substitution could be made if the reflection coefficients of the equivalent medium, as a function of angle of incidence, corresponded to the reflection coefficients of the plasma slab. The dielectric constant of the equivalent medium is found by matching reflection coefficients at some particular angle of incidence (usually 0°). The range of angular correspondence is narrow (less than 5°) for cases in which the dielectric constant dips to near or below zero. In other cases fairly wide ranges of equivalence occur. Author

N66-34061# Navy Dept. Washington, D. C.
DETECTION OF THE RAPID HALATION OF PHOTOIONIZATION AND THE CLOUD OF CONCENTRATED LONG-LIFE IONIZATION RESULTING FROM THE SHOCK WAVE OF A SPARK IN A LASER BEAM [OBNARYZHENIE BYSTROGO OREOLO FOTOIONIZATSII I OBLAKA KONTSENTRIROVANNOI DOLGOZHIVUSCHEI IONIZATSII OT UDARNOI VOLNY ISKRY V LUCHE LAZERA]
G. A. Askar'yan, M. S. Rabinovich, M. M. Savchenko, and A. D. Smirnova [1966] 4 p refs Transl. into ENGLISH from Zh. Eksperim. Teor. Fiz. (Moscow), v. 1, no. 6, 15 Jun. 1965 p 18–23 *Its* Transl. No. 2145
(TT-66-61469; AD-634161) CFSTI: HC $1.00/MF $0.50

The halation of ionization from photons of a light spark was investigated, using super high frequency radio radiation, for a ruby laser with a Q-factor modulated by the prism rotation. Radiation from the laser was focused with a five cm focal length lens located between the receiving horn with the detector and an antenna generator for eight mm wavelength radio radiation. A long lifetime of the halation plasma on the order of hundreds of microseconds was detected. D.T.

N66-34074*# Rensselaer Polytechnic Inst., Troy, N. Y. Plasma Research Lab.

RADIATION TEMPERATURE MEASUREMENTS OF THE NITROGEN AFTERGLOW PLASMA

J. H. Noon and E. H. Holt Jun. 1966 10 p refs *Its* Tech. Rept.-66-4 Submitted for Publication

(Grant NsG-48)

(NASA-CR-77079) CFSTI: HC $1.00/MF $0.50 CSCL 20I

Measurements at microwave frequencies of the radiation temperature of a nitrogen afterglow plasma show that at early post-discharge times a secondary source of electron heating exists, and that microwave conductivity values calculated on the basis of a Maxwellian form for the electron velocity distribution function are anomalous. The evidence points to non-Maxwellian electron velocity distributions in the early afterglow. Author

N66-34076*# Iowa State U., Iowa City. Dept. of Physics and Astronomy.

SCATTERING OF ENERGETIC PARTICLES BY LABORATORY PLASMAS

David Montgomery, Celso Roque, and Igor Alexeff (Oak Ridge National Lab.) Jun. 1966 27 p refs Sponsored in part by AEC *Its* Rept.-66-25

(Grant NsG-233-62)

(NASA-CR-77120) CFSTI: HC $2.00/MF $0.50 CSCL 20I

Expressions for scattering coefficients in terms of the electric field auto-correlation function are derived. Sample situations are considered. Whereas incoherent scattering of electromagnetic waves is governed by the charge density auto correlation function, energetic particle scattering is governed by the electric field auto correlation function. Author

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N66-32702# Library of Congress, Washington, D. C. Aerospace Technology Div.

GROWTH AND FERROELECTRIC PROPERTY OF LITHIUM TANTALATE AND LITHIUM NIOBATE SINGLE CRYSTALS

John G. Kourilo *In its* Foreign Sci. Bull., Vol. 2, No. 6 Jun. 1966 p 19-25 refs (See N66-32699 19-34)

New developments in Soviet research on $LiTaO_3$ and $LiNbO_3$ single crystals are reviewed in light of American reports on prospects for use of these materials in nonlinear optics and microwave techniques. The single crystals were obtained by two techniques: Czochralski and from fluxed melt. Lithium tantalate was classified as a hard ferroelectric with Curie point at 630°C and a likely ilmenite-type crystal structure which does not change on transition to the paraelectric state. Lithium niobate was variously classified as a "frozen" ferroelectric or uniaxial ferroelectric with Curie point near 1140°C. The nature of phase transitions in $LiNbO_3$ below the Curie point was discussed. Author

N66-32707# Massachusetts Inst. of Tech., Cambridge.

SOLID-STATE AND MOLECULAR THEORY GROUP Quarterly Progress Report

15 Apr. 1966 56 p refs

(Contracts Nonr-1841(34); AF 19(628)-356; Grants NSF G-24908; NSF GP-3241)

(QPR-60; AD-632611) CFSTI: HC $3.00/MF $0.50

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6. ELECTROSTATIC AND DIPOLAR MAGNETIC FIELDS IN CUBIC CRYSTALS D. E. Ellis, A. J. Freeman, and P. Ros p 31-45 refs (See N66-32713 19-26)

7. NOTE ON THE BIPOLAR EXPANSION OF $1/r_{12}$ D. E. Ellis p 46-47 refs (See N66-32714 19-24)

N66-32709# Massachusetts Inst. of Tech., Cambridge.

SPIN DENSITY IN IRON

P. De Cicco and A. Kitz *In its* Solid-State and Mol. Theory Group 15 Apr. 1966 p 9-12 refs (See N66-32707 19-26) CFSTI: HC $3.00/MF $0.50

The energy band theory calculation of the spin density in iron is discussed. A spin-dependent atomic potential was constructed from the charge and spin densities assigned to the atoms in the crystal, and by solving the radial Schroedinger equation for the occupied states, one-electron energies were obtained. By combining appropriately the squares of the solutions of the radial equation, contributions to the radial spin density are found from the closed shells as well as from the d-electrons; the contribution of the core states to the spin density is in the region of interest less than two per cent of the total. Tabulated data indicate that where the spin density is large, and therefore has a significant effect on the exchange potential, the spin density constructed from the spin independent calculation is within 10 percent of that obtained from the spin dependent calculation. Density calculations are also made for radial spin and radial charge. R.Li.

N66-32710# Massachusetts Inst. of Tech., Cambridge.

ON GENERALIZED SYMMETRY GROUPS IN CRYSTALS

A. Kitz *In its* Solid-State and Mol. Theory Group 15 Apr. 1966 p 13-19 refs (See N66-32707 19-26) CFSTI: HC $3.00/MF $0.50

Mathematical principles in technical reviews dealing with symmetry groups in magnetic crystals and other generalizations of crystallographic groups are briefly discussed. Some of those reported are: magnetic and ordinary space groups, Shubnikov and color symmetry groups, and abstract, cyclic, and cryptic groups. R.Li.

N66-32713# Massachusetts Inst. of Tech., Cambridge.

ELECTROSTATIC AND DIPOLAR MAGNETIC FIELDS IN CUBIC CRYSTALS

D. E. Ellis, A. J. Freeman, and P. Ros *In its* Solid-State and Mol. Theory Group 15 Apr. 1966 p 31-45 refs (See N66-32707 19-26) CFSTI: HC $3.00/MF $0.50

Magnetic dipolar fields and electrostatic fields in cubic crystals are discussed in terms of theoretical interpretations for experimental work. Continued work is reported on the computation of matrix elements of the electrostatic field for cubic crystals with particular reference to overlap effects from neighboring ions. Crystal expansion for the operator P_l^0/r_{ij}^{l+1} are developed and the result applied to compute the dipolar magnetic field in nickel. Also calculated are matrix elements

for certain typical basis functions; the matrix elements are found to be of the order 10^{-3} a.u. for the nickel basis and an order of magnitude larger for the ligand basis. R.L.

N66-32829# Los Alamos Scientific Lab., N. Mex.
WIEDEMANN–FRANZ–LORENTZ LAW AND ITS APPLICATION IN THE HIGH-TEMPERATURE FIELD
Roberto Evangelisti 2 May 1966 20 p refs Transl. into ENGLISH from Riv. Ing. (Milan), v. 14, no. 8, 1965 p 761–771
(LA-TR-66-22)

Utilizing the Wiedemann–Franz–Lorentz law, analytic expressions were derived for the electric and thermal conductivities of metals in the temperature range of 100 to 1000°C. NSA

N66-32837# Cornell Univ., Ithaca, N. Y. Dept. of Engineering Physics.
HARD SUPERCONDUCTING MATERIALS Annual Progress Report, 1965–1966
J. Silcox and W. W. Webb [1966] 9 p refs
(Contract AT(30-1)-3029)
(NYO-3029-9) CFSTI: HC $1.00/MF $0.50

The experimental facilities at Cornell for investigating the behavior of large current carrying superconductors are briefly described. Brief summaries of investigations made on the following are presented: low frequency a-c response of superconductors, magnetization and critical currents of annealed and cold worked Type II alloys, tracing of individual fluxoids by quantum interference methods, pressure effects in superconductors, hysteresis observations using NMR field measurements, and magnetization mapping techniques. NSA

N66-32839# Sandia Corp., Albuquerque, N. Mex.
THE EFFECT OF POROSITY AND GRAIN SIZE ON THE PULSE ELECTRICAL STRENGTH OF MAGNESIUM OXIDE
E. K. Beauchamp Apr. 1966 27 p refs Presented at the Am. Ceram. Soc. Meeting, Washington, D. C.
(Contract AT(29-1)-789)
(SC-DC-66-1509; CONF-660505-3) CFSTI: HC $2.00/MF $0.50

Pulse electrical strength measurements were made on hot pressed magnesium oxide containing 0.3% lithium fluoride. A simple recessed-electrode configuration eliminated corona effects. Strengths as high as 5900 volts/mil were obtained on samples of 99.9% theoretical density and 1 to 3 micron grain size. A monotonic decrease in strength occurred with an increase of either porosity or grain size.
Author (NSA)

N66-32840# Iowa State Univ. of Science and Technology, Ames.
MICROWAVE HALL MOBILITIES OF HOLES IN GERMANIUM
Bou-loong Ho (Ph.D. Thesis) Feb. 1966 68 p refs
(Contract W-7405-ENG-82)
(IS-T-77) CFSTI: HC $3.00/MF $0.75

Hall mobilities of three p-type germanium crystals were measured at microwave frequencies of 9.5 G Hz from room temperature to near liquid helium temperatures by means of a newly designed bimodal rectangular cavity. The microwave Hall mobilities were compared with the corresponding d-c Hall mobilities. As the temperature was decreased, the microwave Hall mobility began to deviate from the d-c Hall mobility at about 200°K for each of the less pure samples 439GP and GPI, but not until 150°K for the purest sample 439HGP. The difference between the microwave and d-c Hall mobilities at low temperatures was greater in the order 439GP > GPI > 439HGP, whereas the purity of the samples followed the opposite order 439HGP > GPI > 439GP. The difference between the microwave and d-c Hall mobilities can be explained in terms of a high frequency inertial effect in which the relaxation time depends upon scattering of the holes by impurities as well as by phonons. This inertial effect accounts for the experimental results: one, at low temperatures, the microwave Hall mobility was always lower than the corresponding d-c Hall mobility; and two, an increase in impurity scattering always increased the difference between the microwave and d-c mobilities of the holes.
Author (NSA)

N66-32865# California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials.
SUPERCONDUCTIVITY OF LaAg
C. C. Chao, H. L. Luo, and T. F. Smith Mar. 1966 10 p refs
(Contract AT(04-3)-221)
(CALT-221-15) CFSTI: HC $1.00/MF $0.50

The intermetallic compound LaAg was found to become superconducting at 0.9°K. The electric resistivity was measured by the standard four-wire method, using a Leeds and Northrup K-3 potentiometer from room temperature down to 4.2°K. Pressure effects on superconducting transition temperatures were investigated. The results are discussed. NSA

N66-33047# Israel Program for Scientific Translations, Ltd., Jerusalem.
DETERMINATION OF LIGHT ELEMENTS IN SILICON AND OTHER MATERIALS BY NEUTRON ACTIVATION
E. M. Lobanov, V. I. Zvyagin, B. P. Zverev, and D. I. Blinkov *In its* Activation Analysis 1966 p 1–12 refs (See N66-33046 19-06) CFSTI: $4.00

Methods for determinations of light element impurities in materials for semiconductor devices are discussed. The concentrations of these electrically active impurities in high purity germanium and silicon should not exceed 10^{-7} and 10^{-9} respectively, and it is stated that the sensitivity of the common methods of chemical analysis and spectroscopy are too low at these concentrations. Low effective activation cross sections and short half lives also prevent the use of certain promising neutron activation analytical methods for these impurity determinations. Methods are discussed using the reaction of $B^{10}(n,\alpha)Li^7$ to determine boron in silicon, recording α-particles produced in this reaction with nuclear emulsions, and the determination of boron impurity in silicon using the counting properties of silicon single crystals. Additionally discussed is the possibility of determining hydrogen and other light elements in semiconducting materials by recording the recoil nuclei of light elements by means of a p–n junction prepared from the silicon being studied, which is irradiated with 14.1 MeV neutrons. H.S.W.

N66-33049# Israel Program for Scientific Translations, Ltd., Jerusalem.
POSSIBILITIES OF SETTING UP A NEUTRON-ACTIVATION ANALYSIS MODEL FOR SPECIAL-PURITY SUBSTANCES
I. A. Maslov and A. P. Obukhov *In its* Activation Analysis 1966 p 18–21 refs (See N66-33046 19-06) CFSTI: $4.00

A mathematical model is proposed for determining the impurity content of a sample by comparing its activity with a standard activity. The model applies to a group of special purity materials, such as silicon, quartz glass, water, carbon, and sulfur, weakly activated by neutrons. The procedure for direct gamma spectroscopic activation analysis of special purity silicon was examined to test the error with the nature of the element being determined. It is shown that the relative square error of analysis is independent of the nature of the element. H.S.W.

N66-33108# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.

THE EFFECT OF FAST NEUTRON IRRADIATION ON THE MAGNETIC PROPERTIES OF TWO SILICON–IRON ALLOYS

J. Stephen Jan. 1966 20 p refs

(AERE-R-5194) HMSO: 4s

This report describes a fast neutron irradiation experiment conducted on two silicon–iron alloys. The changes in the magnetic properties are given for an irradiation dose of 1.6×10^{20} fast neutrons/cm^2 at temperatures below 135° C. Both alloys exhibit a damage threshold at a dose of about 1.25 to 5×10^{17} fast neutrons/cm^2, above which the saturation and remanent fluxes decrease and the coercivity increases. These changes then remain constant for a further large increase in the fast neutron dose. The results are discussed in terms of the interaction between the inclusions and internal stresses due to the radiation and the domain walls. Author

N66-33110# United Kingdom Atomic Energy Authority, Risley (England). The Reactor Group.

THE EFFECT OF DEFECTS ON THE BASAL PLANE THERMAL CONDUCTIVITY OF A GRAPHITE CRYSTAL. PART I: THEORY

B. T. Kelly 6 May 1966 14 p refs

(TRG-1239(C), Pt. I) CFSTI: HC $1.00/MF $0.50

The theory of the principal conductivities of a graphite crystal is considered in the relaxation time approximation using theoretical treatments of the lattice vibration spectrum. The results are applied to the calculation of the effect of grain boundaries on the basal plane conductivity of a graphite crystal. The effect of point defects and isotopes is treated using the harmonic mean free path for phonon scattering. In each case an approximation to the graphite lattice in which the layer planes are uncoupled is assumed. It is shown that the effect of point defects and isotopes on the "out-of-plane" vibrations of the graphite lattice is similar to that on the in-plane vibrations. Author

N66-33148# California Univ., Riverside. Dept. of Physics.

SPIN WAVE–SPIN WAVE SCATTERING IN A HEISENBERG FERROMAGNET Technical Report No. 3

Robert Gerald Boyd (Ph.D. Thesis) Jan. 1965 50 p refs

(Grant AF-AFOSR-523-64)

(AD-613606) CFSTI: HC $3.00/MF $0.75

Consideration is given to the scattering on one spin wave from another in a perfect simple cubic Heisenberg ferromagnet with nearest neighbor exchange only. An orthonormal set of two-spin-wave states is displayed, and the exchange hamiltonian is divided into a diagonal part and an off-diagonal part. The Lippmann-Schwinger scattering equation is solved for two spin derivations, and an exact exchange scattering cross section is obtained. The 'Golden Rule' is used to derive, in Born approximation, the dipole scattering cross section. It is concluded that if the Born approximation is valid for dipole scattering and if the ratio of cross sections is similar for face centered cubic lattices, then in EuS dipole scattering swamps out exchange scattering at low temperatures. TAB

N66-33206# Joint Publications Research Service, Washington, D. C.

SOVIET SUPERCONDUCTOR RESEARCH

19 Jul. 1966 104 p refs Transl. into ENGLISH from the book "Metallovedeniye i Metallofizika Sverkhprovodnikov. Trudy i Soveshchaniya, po Metallovedeniyu i Metallofizike Sverkhprovodnikov, 25–27 Maya 1964 g." Moscow, Nauka Publishing House, 1965 p 3–16, 39–75, 101–114, 120–122

(JPRS-36575; TT-66-33006) CFSTI: $3.00

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9. METALLIC CRYOSTATS FOR SUPERCONDUCTING SOLENOIDS A. B. Fradkov p 82–88 refs (See N66-33215 19-26)

10. INSTALLATION FOR MEASUREMENT OF CRITICAL TEMPERATURE OF SUPERCONDUCTORS S. Sh. Akhmedov and T. N. Vylegzhanina p 89–91 (See N66-33216 19-26)

N66-33207# Joint Publications Research Service, Washington, D. C.

STATUS AND PROBLEMS OF SCIENTIFIC RESEARCH WORK ON SUPERCONDUCTING METALS

Ye. M. Savitskiy *In its* Soviet Superconductor Res. 19 Jul. 1966 p 1–19 refs (See N66-33206 19-26) CFSTI: $3.00

The current state of the art of superconducting metals is reviewed, and applications in such fields as controlled thermonuclear reactors, high capacity accelerators, magnetohydrodynamic generators, and masers are discussed. The influence of metallurgical factors on the characteristics of superconducting metals, alloys, and compounds are considered. A basic plan for scientific research on superconducting materials is set forth, and it is pointed out that emphasis should be placed on optimization of available alloys. It is recommended that the research and experimental work of designing superconducting solenoids and cryostats be increased. L.E.W.

N66-33208# Joint Publications Research Service, Washington, D. C.

INFLUENCE OF ALLOYING ADDITIONS ON SUPERCONDUCTING PROPERTIES OF ALLOYS OF NIOBIUM AND ZIRCONIUM

L. F. Myzenkova, Yu. V. Yefimov, V. V. Baron, and Ye. M. Savitskiy *In its* Soviet Superconductor Res. 19 Jul. 1966 p 20–25 refs (See N66-33206 19-26) CFSTI: $3.00

The influence of small additions of iron, lanthanum, cerium, and titanium on the critical current density of niobium alloys of 25 and 50% zirconium was investigated. It was found that if the additions were no greater than trace amounts

on the order of 0.1 to 1 wt% for each metal, the critical current density would increase. In another investigation it was found that the influence of magnetic field intensity on critical current density was approximately the same for niobium alloys both with and without the additives. Finally, it was determined that heat treatment, under an optimal regime, can significantly increase the critical current densities of the niobium alloys rafted with cerium and lanthanum. D.T.

N66-33209# Joint Publications Research Service, Washington, D. C.

INFLUENCE OF STRUCTURAL STATE ON SUPERCONDUCTING PROPERTIES OF ALLOYS OF ZIRCONIUM WITH 20–25 PERCENT NIOBIUM

Yu. F. Bychkov, I. N. Goncharov, and I. S. Khukhareva *In its* Soviet Superconductor Res. 19 Jul. 1966 p 26–38 refs (See N66-33206 19-26) CFSTI: $3.00

The influence of structure and defects on the critical current density and the connection between transition temperature and structure in zirconium–niobium alloys are discussed. The methods of preparation and measurements are described. It was found that the most important results of intermediate temper of the 20–25% Nb alloys at 400° to 550°C are the sharp increase of critical current density, comparatively weak dependence of the critical current density on external magnetic field and an almost full absence of anisotropy of critical current density in the area of ω-phase separation. A lowering of internal friction during annealing at 400–500°C indicates a decrease in point and linear defects. Intermediate annealing apparently increases the ability of alloy for formation of dislocations during subsequent cold deformation. Details are presented on the transition temperature dependence on structure, tempering, and annealing. N.E.N.

N66-33210# Joint Publications Research Service, Washington, D. C.

SUPERCONDUCTING PROPERTIES OF NIOBIUM–TITANIUM ALLOYS AND INFLUENCE OF ALLOYING ADDITIONS ON CRITICAL DENSITY OF CURRENT

V. V. Baron, M. I. Bychkova, and Ye. M. Savitskiy *In its* Soviet Superconductor Res. 19 Jul. 1966 p 39–47 refs (See N66-33206 19-26) CFSTI: $3.00

The changes in the critical current density of various compositions of niobium–titanium alloys, and the influence of small additions of certain elements on the characteristics and mechanical properties of these alloys were investigated. The experimental procedures used are outlined and charts and graphs which summarize the data obtained are provided. H.S.W.

N66-33211# Joint Publications Research Service, Washington, D. C.

SUPERCONDUCTING PROPERTIES OF VANADIUM–TITANIUM

Yu. V. Yefimov, V. V. Baron, and Ye. M. Savitskiy *In its* Soviet Superconductor Res. 19 Jul. 1966 p 48–55 refs (See N66-33206 19-26) CFSTI: $3.00

The superconducting properties of vanadium–titanium alloys were investigated to assess the value of using these alloys in the manufacture of superconducting solenoids. The mechanical properties, microstructure, and the influence of ausforming on the mechanical and superconducting properties of these alloys were also studied. It was found that heat treatment increased the current density; however, a combination of heat treatment and cold deformation, for alloys rich in vanadium, was more effective. Additional findings are discussed and the data obtained is summarized. H.S.W.

N66-33212# Joint Publications Research Service, Washington, D. C.

SUPERCONDUCTIVITY OF REFRACTION COMPOUNDS

G. V. Samsonov *In its* Soviet Superconductor Res. 19 Jul. 1966 p 56–64 refs (See N66-33206 19-26) CFSTI: $3.00

A review on superconductivity values for refractory compounds resulted in the following conclusions: (1) Superconducting properties in compounds of the same transition metals with different nonmetals increased with growth of the nonmetal ionization potential in the direction from silicides to borides, carbides, and nitrides; (2) the probability of superconducting properties increased with a lower acceptance ability of the transition metal atom down to 5 electrons on the d-shell; (3) the highest critical temperature values were usually found for niobium and molybdenum semiconducting compounds and to a much lesser degree for vanadium, tantalum, and tungsten compounds with nonmetals; and (4) a relative nonmetal content decrease in metal-like phases lowered the critical temperature values. It was concluded that the formation of superconducting compounds drops with the increased filling of free states on d-shells by valence electrons of nonmetal atoms; therefore silicides, borides, carbides, and nitrides of transition metals evolved as strong acceptors of electrons. G.G.

N66-33213# Joint Publications Research Service, Washington, D. C.

PRODUCTION AND STUDY OF WIRE FROM SUPERCONDUCTING NIOBIUM–ZIRCONIUM ALLOYS

I. A. Baranov, R. S. Shmulevich, V. R. Karasik, and G. B. Kurganov *In its* Soviet Superconductor Res. 19 Jul. 1966 p 65–69 ref (See N66-33206 19-26) CFSTI: $3.00

The production of wire from superconducting niobium–zirconium alloys through electron furnace melting is reported. Ingots were twice remelted and a maximum hardness of 260 to 270 kilogram-force mm^2 was obtained by all wires containing 40 to 50 percent Zr. Their forging structure constituted equixial grains of solid solution with some unimportant separation of the second phase. The greatest critical current density was found in alloys of niobium with 25 to 27% zirconium. A short model of Nb–26% Zr wire possessed a critical current density of $6 \cdot 10^4$ a/cm^2 in a field of 44 ke. G.G.

N66-33214# Joint Publications Research Service, Washington, D. C.

SUPERCONDUCTING SOLENOIDS FROM NIOBIUM WITH ZIRCONIUM ALLOYS

V. R. Karasik, G. B. Kurganov, V. G. Yershov, I. Yu. Shebalin, B. D. Kopylovskiy et al *In its* Soviet Superconductor Res. 19 Jul. 1966 p 70–81 refs (See N66-33206 19-26) CFSTI: $3.00

Small sized solenoids made from superconducting niobium–zirconium alloys were tested for their ability to obtain strong magnetic fields. Several thin-walled selenoid frames, carrying differing length of 25% Zr–75% Nb wiring of about 0.2 to 0.25 mm diameter, were tested in metallic cryostats for periods of up to 8 months; the selenoids were fed from six-volt currents through rheostats and the current was regulated by switching diodes. Conducted evaluations showed that these selenoids reached magnetic field intensities of ~50 ke. G.G.

N66-33215# Joint Publications Research Service, Washington, D. C.

METALLIC CRYOSTATS FOR SUPERCONDUCTING SOLENOIDS

A. B. Fradkov *In its* Soviet Superconductor Res. 19 Jul. 1966 p 82–88 refs (See N66-33206 19-26) CFSTI: $3.00

The designs of cryostats for solenoids with a magnetic field strength of 50 to 60 ke are described. Cryostat arrangements for testing superconducting solenoids, and for solenoids with working volumes at room temperature are shown schematically. The calculation of liquid helium consumption used in solenoid cooling is explained, and results determined during various operational modes of cryostats are presented. A study of conditions appearing during sudden transition of solenoid from superconducting to normal state indicates that transition with temperatures of liquid helium at 2.2°K leads to corresponding heating of liquid without increase in cryostat pressure above the atmospheric. From the experiments conducted it is concluded that the designs described are useful for fields on the order of 50–60 thousand e in volume to several hundreds of cubic centimeters. A.G.O.

N66-33216# Joint Publications Research Service, Washington, D. C.

INSTALLATION FOR MEASUREMENT OF CRITICAL TEMPERATURE OF SUPERCONDUCTORS

S. Sh. Akhmedov and T. N. Vylegzhanina *In its* Soviet Superconductor Res. 19 Jul. 1966 p 89–91 (See N66-33206 19-26) CFSTI: $3.00

Details are given on instrument installations for measuring the critical temperature of superconductors by resistance, and by magnetic moment. All measurements are conducted in glass cryostats, with a Dewar vessel used to regulate the temperature of volume in which the model is found. Small wires are usually used for resistance measurements. For diamagnetic effect measurements, two coils with an identical number of turns are installed, and the coils are engaged counterclockwise. To develop an alternating magnetic field, a superconducting solenoid is used. M.G.J.

N66-33386*# Illinois Univ., Urbana.

ANNEALING OF NEUTRON-IRRADIATION-INDUCED CHANGES IN IMPURITY CONDUCTION IN ANTIMONY-DOPED GERMANIUM

E. L. Wolf and W. Dale Compton [1965] 15 p refs

(Grant NsG-228-62)

(NASA-CR-77037) CFSTI: HC $1.00/MF $0.50 CSCL 20L

Germanium doped with antimony in the range of 1 to 2×10^{17} atoms/cm^3 exhibits a temperature independent resistivity at less than 10°K. As acceptor states are introduced by irradiation with fast neutrons, it is found that the low temperature resistivity exhibits an activation energy ϵ_2. Since the magnitude of ϵ_2 depends upon the distribution and the number of occupied donors, this parameter is useful for studying the thermal stability of the defects that are introduced by irradiation. It is found in these highly doped materials that the motion of charged defects to form neutral complexes does not seem to involve the neutral donors. Author

N66-33436*# General Dynamics Corp., San Diego, Calif. Special Nuclear Effects Lab.

RADIATION EFFECTS ON SILICON Sixth Quarterly Progress Report, Apr. 1–Jun. 30, 1966

H. Horiye, J. A. Naber, and E. G. Wikner 11 Jul. 1966 15 p refs

(Contract NAS7-289)

(NASA-CR-77053; GACD-6249) CFSTI: HC $1.00/MF $0.50 CSCL 20L

Efforts during this period were concentrated on investigating the damage and annealing properties of high purity n-type silicon after irradiation at 4.2°K with 25 MeV electrons. Additional experiments were performed to verify some of the results and conclusions drawn last period on the annealing characteristics of the E center. R.N.A.

N66-33475# Norwegian Defence Research Establishment, Kjeller.

CURRENT OSCILLATION AND SATURATION IN CADMIUM SULPHIDE

L. O. Svaasand 17 Jan. 1966 11 p refs *Its* Sci. Rept.-12

(Contract AF 61(052)-484)

(AFCRL-66-432; AD-634725L) CFSTI: HC $1.00/MF $0.50

Experiments were performed in order to explain the observed double current saturation in CdS. The phenomenon appears to be caused by simultaneous acoustic oscillation in a shear mode and a longitudinal mode. Current oscillations in the 25–35 MHz range were also observed but no adequate explanation can be given. Author (TAB)

N66-33491*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

CALCULATION OF FUNCTIONALS OF MATRICES ARISING IN SOLID STATE PHYSICS AND QUANTUM CHEMISTRY

Phillip B. Abraham Jul. 1966 254 p refs

(NASA-TM-X-55551; X-611-66-303) CFSTI: HC $3.75/MF $1.50 CSCL 20B

Techniques for the evaluation of analytic functions of matrices associated with physical and chemical systems that are characterized by the repetition of identical units are given. A method consisting of Poisson-type transformations of finite sums, which lead to rapidly converging expressions for the problems considered, is demonstrated. Examples related to crystal lattice dynamics and molecular orbital theory are discussed. Certain restricted sums of perturbation theory are calculated exactly by a method of independent interest. An extensive list of matrices arising from diverse periodic systems, together with their eigenvalues and eigenvectors, is presented. Author

N66-33580# Colorado State Univ., Fort Collins. Dept. of Physics.

STUDIES, RESEARCH AND INVESTIGATIONS OF THE OPTICAL PROPERTIES OF THIN FILMS OF METALS SEMICONDUCTORS AND DIELECTRICS Semiannual Report, 16 Aug. 1964–15 Feb. 1965

Lawrence W. Hadley and Kerry Shaklee [1965] 12 p

(Contract DA-44-009-ENG-3828)

(SAR-11; AD-634034) CFSTI: HC $1.00/MF $0.50

The primary emphasis was further work on films of chromium with hope for an understanding of the reasons for the failure of the method of determining optical constants from measurements of reflectance, transmittance and thickness in the case of chromium. No solution was found, but the investigations yielded some information. X-ray diffraction analysis of Cr films showed a preferred orientation of the Cr on quartz. Only the (110) line of Cr could be observed on the spectrogoniometer. Either this makes Cr lattice spacings fit quartz more closely, or possibly this gives the greatest population density. A Cr film evaporated to a thickness of 1000 Å on quartz at 500°C in 1/2 second was found to have a crystallite size of 190 Å ± 10 Å. An effort was also made to push the measurements of the optical constants of TiO_2 out to the IR and UV by use of the curves. The same difficulties in determining n and k occurred as previously. Author (TAB)

N66-33604# Naval Research Lab., Washington, D. C.

ELECTRODYNAMICS OF A SUPERCONDUCTING PARALLEL PATH CIRCUIT

Everett E. King 9 May 1966 78 p refs

(NRL-6410; AD-633685) CFSTI: HC $3.00/MF $0.75

In order to understand better the behavior of superconductors in electrical circuitry, a detailed study is presented of a circuit composed of two superconducting inductances connected in parallel. This circuit forms a closed superconducting path through which the magnetic flux will remain constant

only if the resistance of the superconductor is zero. In this regard, an upper limit for the dc resistivity of a superconductor is found by two methods. The first method appears in the literature several times and consists of an attempt to detect the decay of a persistent current. The second method has not been reported previously and consists of an attempt to observe between the two branches a current distribution different from that which conserves the flux linkage. These methods differ in that, in the first method, the persistent current exists entirely within the superconductor; whereas, in the second method, the externally supplied current must both enter and leave the superconductor. The transient response of the circuit is investigated. Also, the flux linkage is verified to remain constant to within an experimental error of about 1 for current changes as short as about 1 microsecond. Author (TAB)

N66-33624# Colorado State Univ., Fort Collins.
STUDIES, RESEARCH AND INVESTIGATIONS OF THE OPTICAL PROPERTIES OF THIN FILMS OF METALS, SEMICONDUCTORS AND DIELECTRICS Semiannual Report, Feb. 15–Aug. 15, 1965
Lawrence N. Hadley [1965] 11 p refs
(Contract DA-44-009-ENG-3828)
(SAR-12; AD-634035) CFSTI: HC $1.00/MF $0.50

MODIFICATION OF THE SHUTTER SYSTEM: The driving motor for the shutter system used in the vacuum system was replaced by a helical spring and the shutter was replaced by a slotted 12-in.-diameter disk. This was done to permit (1) complete preparation of films without breaking the vacuum and (2) deposition times of the order of tenths of seconds or greater. MODIFICATION OF THE BECKMAN DK-2 SPECTROPHOTOMETER: A device was installed in the integrating sphere so that absolute measurements of the reflectance of films could be made. The modification reduces labor in correcting the reflectance curves and minimizes handling of the mirrors. OPTICAL MEASUREMENTS: Attempts were made with various materials to obtain n and k from Hadley's curves (Transmittance and Reflectance vs. thickness/wavelength for thin film's) and to determine why satisfactory results were not obtained. Values of n and k were obtained at several wavelengths for aluminum, bismuth, and copper but not for silver. TAB

N66-33627# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTRONOGRAPHIC INVESTIGATION OF THE NATURE OF CRYSTAL ORIENTATION AND FORMATION OF PHASES IN $SnSb_2Te_4$ AND $PbBi_4Te_7$ COMPOUNDS
A. G. Talybov 17 Mar. 1966 17 p refs Transl. into ENGLISH from Azerb. Khim. Zh. (Baku), v. 30, no. 6, 1963 p 111–118
(FTD-TT-65-1399/1+2+4; AD-633672) CFSTI: HC $1.00/MF $0.50

The nature of crystal orientation in $SnSb_2Te_4$ and $PbBi_4Te_7$ compounds was investigated. It was established that in the case of sublimation of $SnSb_2Te_4$ alloy on a celluloid film and rock salt without subsequent annealing thin polycrystalline films are obtained. To obtain textured or monocrystalline film, it is necessary to sublimate this alloy on hot NaCl layers with subsequent annealing. When investigating samples of $SnSb_2Te_4$, the sublimation condition plays a greater role for the alloy. It was established that in the dependence upon the number of sublimation, the nature of orientation of crystals and chemical composition of the film change. The film of the basic alloy $SnSb_2Te_4$ is obtained at one sublimation only. It was established that the orientation of crystals of compounds $PbBi_4Te_7$ in thin layers at various annealing conditions is different. In contrast to $SnSb_2Te_4$ compound. The compound $PbBi_4Te_7$ does not change in composition from the sublimation conditions. Author (TAB)

N66-33633# Lehigh Univ., Bethlehem, Pa.
CONDUCTIVITY OF LITHIUM-SUBSTITUTED TRANSITION METAL OXIDES CONTAINING MAGNESIUM
W. C. Hahn, Jr. Jun. 1966 4 p refs
(Contract Nonr-4373(00))
(AD-634061) CFSTI: HC $1.00/MF $0.50

$Li_x Ni_{(1-x)}O$, $Li_x Mn_{(1-x)}O$, and $Li_xCO_{(1-x)}O$. It is proposed in this investigation to measure the effect on the room temperature specific resistivity of additions of MgO to systems such as $Li_xNi_{(1-x)}O$, $Li_xMn_{(1-x)}O$, and $Li_xCO_{(1-x)}O$. Because the divalent state of manesium is so stable, it will not enter divalent state of magnesium is so stable, it will not enter into the conductivity process directly, but it can be anticipated that it can confer several beneficial results on the conductivity in the above named oxide systems. It is realized that extremely large additions of MgO to any of the systems under consideration, as well as additions of MgO to systems in which the amount of lithium is very small, would serve only to increase the resistivity, but it can be anticipated that a region of compositions may be found in which the resistivity will be decreased. An additional reason for adding MgO, and perhaps ultimately the most important, is that existing theories do not explain the maximum in the activation energy observed at approximately 50% nickel in the system $Li_{0.08}Ni_yCo_{(1-.08-y)}O$ observed by Miller, Heikes and Johnston. Author (TAB)

N66-33671*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
MAGNETICS AND SUPERCONDUCTIVITY
Edmund E. Callaghan *In its* Selected Technol. for the Petrol. Ind. 1966 p 73–80 (See N66-33666 19-34) GPO: HC $1.25; CFSTI: MF $0.50

Characteristics of conductors and superconductors at cyrogenic temperatures, and their applications are reviewed. It is pointed out that normal conductors at low temperatures have greatly reduced resistance, and that therefore operating an electrical device at cryogenic temperatures reduces power consumption, even including the power for refrigeration. The thermal resistance, residual resistance, and magnetoresistance components are discussed, and a cryogenic magnet built for operation at liquid neon temperatures is described. The properties of superconductors are presented with emphasis on the exclusion of the magnetic field, and a superconducting magnet is also described. N.E.N.

N66-33676*# National Aeronautics and Space Administration, Washington, D. C.
CONTRIBUTION TO THE THEORY OF THE ADSORPTION EFFECT AT THE SURFACE OF SEMICONDUCTORS AND GELS UNDER THE ACTION OF IONIZING RADIATION [K TEORII ADSORBTSIONNOGO EFFEKTA NA POVERKHNOSTYAKH POLUPROVODNIKOV I GELEY POD DEYSTVIYEM IONIZIRUYUSHCHEGO OBLUCHENIYA]
D. A. Aronov, Sh. A. Ablyayev, U. U. Pulatov, and R. G. Shamasov May 1966 18 p refs Transl. into ENGLISH from Izv. Akad. Nauk Uzbekstoy SSR, Ser. Fiz.-Mat. Nauk (Tashkent), v. 9, no. 5, 1965 p 63–70
(NASA-TT-F-10137) CFSTI: HC $1.00/MF $0.50 CSCL 20L

Discussion of the problem of determining the sign of the adsorption effect for semiconductors and gels as a function of the semiconductor (or gel) parameters and of the test temperature and pressure. A solution is obtained within the framework of the mechanism of electron chemisorption theory, for the case of strong absorption when ionizing radiation leads to the occurrence of electron-hole pairs near the surface. Author

N66-33682*# National Aeronautics and Space Administration, Washington, D. C.
STUDY OF THE PROPAGATION PROCESS OF A REACTION IN SOLID PHASES [IZUCHENIYE PROTSESSA RASPROSTRANENIYA REAKTSII V TVERDYKH FAZAKH]
P. I. Bel'kevich and Ye. S. Osinovik Jun. 1966 26 p refs Transl. into ENGLISH from Izv. Akad. Nauk Belorussk SSR (Moscow), no. 5, 1955 p 149–160
(NASA-TT-F-10226) CFSTI: HC $2.00/MF $0.50 CSCL 20L

The propagation rate of reactions in solid phases was studied on the example of the change in electric conductivity of silver oxalate during thermal dissociation from 105° to 120°C. Tabulated data on decomposition after explosion and velocity–time curves for thermal dissociation are given to demonstrate that the explosive decomposition of silver oxalate on reaching the maximum reaction velocity proves its autocatalytic decomposition under the effect of a solid reaction product. The self-catalysis in topochemical reactions is attributed to the formation of a solid phase related with the crystal lattice of the initial substance. The motion of electrons along a wire, not connected with the crystal lattice of the oxalate, will not cause explosion. Author

N66-33683*# National Aeronautics and Space Administration, Washington, D. C.
ORGANIC SEMICONDUCTORS [ORGANISCHE HALBLEITER]
C. Hamann Aug. 1966 75 p refs Transl. into ENGLISH from Physica Status Solidi (East Germany), v. 12, 1965 p 483–532
(NASA-TT-F-10227) CFSTI: HC $2.50/MF $0.75 CSCL 20L

A broad survey is presented on the semiconductor properties of solid state organic compounds. The following areas are discussed: (1) the basis and theory of charge transport; (2) classes of materials; (3) preparation techniques; (4) measurement methods and results; and (5) possible applications of organic semiconductors. The classes of materials include polycyclic aromatics, organic dyes, halide and alkaline metal complexes, additive complexes between two organic molecules, heterocyclic compounds, natural substances of animal and vegetable origin, and polymers. D.T.

N66-33685*# National Aeronautics and Space Administration, Washington, D. C.
INFRARED QUENCHING OF THE PHOTOVOLTAIC EFFECT IN CADMIUM SULFIDE [INFRACHERVONE GASINNYA FOTOVOL'TAYCHNOGO EFEKTU V SUL'FIDI KADIMUYU]
V. O. Drozdov, Sh. D. Kurmanshev, and O. L. Rvachov Aug. 1966 13 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 11, no. 1, 1966 p 45–58
(NASA-TT-F-10259) CFSTI: HC $1.00/MF $0.50 CSCL 20L

An experimental investigation of the effect of infrared radiation on the photovoltaic effect in cadmium sulfide excited by visible light (600 mμ region of the spectrum) is reported. It is shown that infrared bias illumination can have both a stimulating and suppressing effect, depending on the intensity of the visible light. As distinct from photoconductivity, only one maximum of infrared stimulation (or quenching) is observed for the photovoltiac effect; this maximum corresponds to a wavelength of 0.85μ. Author

N66-33705*# National Aeronautics and Space Administration, Washington, D. C.
EFFECT OF CRYSTALLINE STRUCTURE ON THE PHOTOELECTRIC PROPERTIES OF THIN LAYERS OF CADMIUM SULFIDE [VLIYANIYE KRISTALLICHESKOY STRUKTURY NA FOTOELEKTRICHESKIYE SVOYSTVA TONKIKH SLOYEV SUL'FIDA KADMIYA]
K. V. Shalimova, L. P. Pavlov, and I. A. Karetnikov Aug. 1966 14 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Fiz. (Tomsk), v. 9, no. 1, 1966 p 132–136
(NASA-TT-F-10260) CFSTI: HC $1.00/MF $0.50 CSCL 20L

Results of a study of the photoelectric properties of polycrystalline layers of cadmium sulfide as a function of their method of preparation are given. From a comparison of these results of X-ray structural and electronographic analysis it is found that the spectral distribution of the photocurrent, the absolute and relative photosensitivities, and the relaxation time are highly dependent on the substrate temperature. These differences are associated with a change in the phase composition and the degree of imperfection of the polycrystalline layers of cadmium sulfide. Author

N66-33852# Army Electronics Labs., Fort Monmouth, N. J.
STUDY OF CHARGE CARRIER COLLECTION FROM INSIDE AND OUTSIDE THE SPACE CHARGE REGION
Michael J. Basso Jan. 1966 43 p refs
(ECOM-2660; AD-633774) CFSTI: HC $2.00/MF $0.50

A theoretical and experimental study of the collection of charge carriers produced within and outside the space charge region of a p–n type solid-state radiation detector by incident energetic alpha particles of 4.98, 4.67, 3.87, 2.98, and 2.31 MeV energy is described. The depth of the space charge region was made smaller by a variable forward bias voltage externally applied. The magnitude of the applied voltage was smaller than the barrier potential. Measurements were made of the number of collected carriers from inside and outside the space charge region as the depth of space charge region was varied over the range of the incident alpha particle. The measure results show agreement with the theoretical considerations. The collection efficiency of the detector was also investigated and is given, independent of the particle energy, as a function of the applied bias voltage. Author (TAB)

N66-33889# Lehigh Univ., Bethlehem, Pa.
ENERGY TRANSFER AND THE ROLE OF THALLIUM DIMERS IN THE NaI(Tl) SCINTILLATION PROCESS
W. J. Van Sciver 1966 7 p refs Presented at the IEEE Scintillation and Semicond. Counter Symp., Washington, D. C., 2–4 Mar. 1966
(Contract AT(30-1)-3408)
(NYO-3408-5; CONF-660304-9) CFSTI: HC $1.00/MF $0.50

The thallium dimer center, which is a pair of thallous ions occupying nearest neighbor cation sites in NaI, was found to have a decay time of less than 7 nanoseconds. Analysis of the emission spectrum of a typical NaI(Tl) scintillation crystal indicated that the dimer centers are responsible for approximately 25% of the scintillation light although only a small part of this is rapid. It is proposed that energy of excitation migrates among the monomers and between monomers and dimers as a result of thermal excitation. Author (NSA)

N66-33926# Los Alamos Scientific Lab., N. Mex.
LOCALIZED MOMENTS OF DILUTE Fe IN NONMAGNETIC HOST METALS
R. Dean Taylor [1966] 19 p refs Presented at the Mossbauer Symp., New York
(Contract W-7405-ENG-36)
(LA-DC-7561; CONF-660113-1) CFSTI: HC $1.00/MF $0.50

The behavior of ^{57}Fe impurities in cubic, nonmagnetic elements when subjected to applied fields up to 62 kOe and temperatures down to 0.4°K was investigated by means of the Moessbauer spectra. The performance of this method is discussed. NSA

N66-33927# Academia R. P. R., Bucharest (Romania). Institutul de Fizica Atomica.

INFLUENCE OF THE PERPENDICULAR AND PARALLEL ANISOTROPY ON THE FERROMAGNETIC PROPERTIES OF THIN FILMS

A. Corciovei and G. Costache 1966 11 p refs

(IFA-FT-57)

A further development is presented of a previous theoretical study by Corciovei. The dependence of the spontaneous magnetization on the temperature and the number of monoatomic layers of thin films is calculated. Also, the dependence of Curie temperature vs. the number of monoatomic layers is calculated, taking into account the influence of magnetic perpendicular and parallel anisotropy.

Author (NSA)

N66-33941# Massachusetts Inst. of Tech., Cambridge. Dept. of Physics.

LOW TEMPERATURE STUDIES BY NEUTRON DIFFRACTION Progress Report, 1 Feb. 1965–31 Jan. 1966

15 Feb. 1966 6 p refs

(Contract AT(30-1)-3031)

(MIT-3031-3) CFSTI: HC $1.00/MF $0.50

Further developments for each of the following three research activities are briefly discussed: electronic and nuclear polarization in superconducting V_3Si, magnetization measurements on V_3Si, and nuclear polarization in hexagonal cobalt.

NSA

N66-33958# Cornell Univ., Ithaca, N. Y. Dept. of Engineering Physics.

A STUDY OF IMPERFECTIONS IN CRYSTALS Progress Report, Jun. 15, 1965–May 1, 1966

H. S. Sack 1 May 1966 8 p refs

(Contract AT(30-1)-2471)

(NYO-2471-21) CFSTI: HC $1.00/MF $0.50

Investigations were made on crystal imperfections by relaxation type measurements such as internal friction and dielectric dispersion. Brief summaries of research progress in the following three areas are presented: dipolar impurities in alkali halides, internal friction in plastically deformed metals, and two-photon processes in silver halides.

NSA

N66-33959# Lehigh Univ., Bethlehem, Pa.

ROLE OF THE THALLIUM DIMER IN THE NaI(Tl) SCINTILLATION PROCESS Progress Report

W. J. Van Sciver Apr. 1966 7 p refs

(Contract AT(30-1)-3408)

(NYO-3408-6) CFSTI: HC $1.00/MF $0.50

Experimental research was concerned with (a) measurements of the optical characteristics of the thallium dimer center and (b) determination of parameters which may influence their formation, dissociation, or reorientation. Theoretical research on thallium monomer and dimer centers is described. Only brief results are given.

NSA

N66-34028# Lockheed Missiles and Space Co., Palo Alto, Calif. Research Lab.

NEW STUDIES OF THE BAND STRUCTURE OF SILICON, GERMANIUM, AND GREY TIN

Frank Herman, Richard L. Kortum, Charles D. Kuglin, and Ruth A. Short [1966] 82 p refs

A method was developed for determining the energy band structure of crystals which is more reliable than purely first-principles or purely empirical (pseudopotential or k·p) methods. A reliable theoretical guide is provided for experimental investigations of those optical, photoemissive, and pressure-sensitive properties that depend on the band structure away from the band edges. Superior accuracy is attained by adding a small, carefully chosen empirical correction to an otherwise first-principles band calculation. In addition to obtaining new energy band solutions for silicon, germanium, and grey tin, deformation potentials have been calculated for most of the key interband transitions in silicon and germanium, and compared with the measured values for supposedly related optical reflectivity peaks. Changes in the band structure of germanium produced by major and minor changes in the lattice constant were determined, and the composition dependence of the band structure of the germanium–silicon alloy system was examined.

C.T.C.

N66-34059# Radio Corp., of America, Princeton, N. J.

INVESTIGATION OF TWO-CARRIER INJECTION ELECTROLUMINESCENCE Scientific Report No. 4, 15 Jul. 1965–15 Feb. 1966

Albert G. Fischer and William H. Fonger 14 Mar. 1966 37 p refs

(Contract AF 19(628)-3866)

(AFCRL-66-226; AD-634398) CFSTI: HC $2.00/MF $0.50

Work on the crucial problem of II-VI P-N injection electroluminescence, suppression of self-compensation, was actively pursued. Experiments on photo-uncompensation and on electrolytical vacancy extraction have been inconclusive so far. Work on two new approaches, ion implantation doping and vacancy suppression by very high hydrostatic pressure, was started. The technique to render ZnS, ZnSe, and ZnTe crystals n-type is described in detail. Progress was made in the field of II-VI crystal growth: Epitaxial layers of $ZnSe_xTe_{1-x}$ were grown on n-type ZnSe single-crystal substrates by vapor transport in an open-flow system. Large ZnTe:I crystals were grown in sealed evacuated ampoules of a novel design in a furnace permitting visual inspection. A new class of solvents for solution growth of II-VI crystals was discovered, the group V chalcogenides. Photoluminescent narrow-line emission in neodymium-doped $ZnSe_xTe_{1-x}$ is intensified by coactivation with phosphorus, the spectra and their dependence on various parameters were analyzed.

Author (TAB)

N66-34064# Naval Research Lab., Washington, D. C.

THE APPLICATION OF TOROIDAL GEOMETRY TO HIGH ENERGY STORAGE INDUCTORS

D. S. Toffolo Apr. 1966 13 p

(NRL-MR 1702; AD-634388) CFSTI: HC $1.00/MF $0.50

The equations applicable to toroidal geometry for the design of magnetic energy storage toroids are derived. The energy storage density using superconducting material is considerably better and more economical than capacitative energy storage.

Author (TAB)

N66-34068*# Illinois Univ., Urbana. Dept. of Physics.

AN EXPERIMENTAL INVESTIGATION OF RADIATION EFFECTS IN SEMICONDUCTORS Semiannual Status Report, 1 Jan.–30 Jun. 1966

W. Dale Compton [1966] 20 p refs

(Grant NsG-228-62)

(NASA-CR-77106) CFSTI: HC $1.00/MF $0.50 CSCL 20L

Continuing research on recombination luminescence and tunneling in semiconductors is reported. Studies of the recombination luminescence of optically excited carriers was extended to liquid helium temperatures with a consequent increase in the resolution of the emission bands. Measurements were made on n- and p-type Czochralski grown silicon

irradiated with Co^{60} gamma rays. The ratio of recombination center concentration to gamma ray flux determined by Hall measurements is being investigated. The impurity band formation in the system of antimony donors in germanium was investigated, using a superconducting metal such as lead or niobium in the junction and using a point contact form of tunneling junction. The study of the thermal stability of irradiation induced defects in n-type germanium is reported completed. N.E.N.

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N66-33309*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PERFORMANCE OF JP-4 FUEL WITH FLUORINE–OXYGEN MIXTURES IN 1000-POUND-THRUST ROCKET ENGINES

Donald L. Nored and Howard W. Douglass Washington, NACA, 11 Jun. 1958 35 p refs

(NACA-RM-E58C18) CFSTI: HC $2.00/MF $0.50 CSCL 21I (Declassified)

Seven injectors of four different types were tested for use with JP-4-oxygen–fluorine propellant combinations. High characteristic velocities were obtained over the complete range of 0- to 70-percent fluorine in the oxidant. Combustion pressure in the water cooled thrust chambers was 600 pounds per square inch absolute. The same basic injection requirements apparently prevail for fluorine-rich oxidants as for pure oxygen where simultaneous atomization and mixing of the propellants gave the most favorable results, and atomization along yielded better performance than mixing alone. A triplet injector (atomization with mixing) gave the highest performance and was efficient over wide ranges in oxidant-fuel ratio. However, the design of triplet units seems to be critical. Minor design changes in oxidant orifices resulted in significant shift in performance. Variation in arrangement of triplet units on injector faces greatly influenced the heat transfer rates through the engine walls. A like-on-like injector creating finely divided atomization depended less on engine length for good performance than a triplet injector having coarser sprays. Author

N66-33325*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EXPERIMENTAL HYDROGEN–FLOURINE ROCKET PERFORMANCE AT LOW PRESSURES AND HIGH RATIOS

Carl Aukerman and Bruce E. Church Washington, NASA, Sep. 1963 35 p

(NASA-TM-X-724) CFSTI: HC $2.00/MF $0.50 CSCL 21I (Declassified)

The performance of hydrogen and fluorine was evaluated in an altitude test facility at low chamber pressures in rocket engines having area-ratio-100 exhaust nozzles of three lengths. Chamber pressure ranged from 60 to 10 pounds per square inch absolute and mixture ratio from 12 to 6 percent hydrogen. The nominal thrust was 1400 pounds at a chamber pressure of 60 pounds per square inch absolute. A conical nozzle of 15° half angle produced a vacuum thrust coefficient of approximately 98 percent of one-dimensional theoretical equilibrium and was relatively insensitive to changes in chamber pressure. This value represents near-equilibrium nozzle performance with respect to internal flow characteristics. The maximum vacuum specific impulse measured was 465 pound–seconds per pound. A conical nozzle of 25° half angle and a ball shaped nozzle contoured to 70 percent of the length of the 15° conical had thrust coefficients near frozen expansion for the conditions tested. The lower performance of the two shorter nozzles was attributed to the failure of the dissociated exhaust products to recombine at high expansion rates. Author

N66-33433*# Brown Engineering Co., Inc., Huntsville, Ala. Research Labs.

EFFECTIVE MOMENT OF INERTIA AND VELOCITY RATIO FOR LIQUID-FILLED CYLINDRICAL TANKS OSCILLATING ABOUT THE LONGITUDINAL AXIS

J. L. Diven Mar. 1966 60 p refs

(Contract NAS8-20073)

(NASA-CR-76861; R-182) CFSTI: HC $2.00/MF $0.50 CSCL 21I

The Navier–Stokes equations are solved exactly for the motion of the liquid in a liquid-filled cylindrical tank with oscillation about the longitudinal axis. The moment due to the viscous shear at the tank wall is calculated. Equations for the effective moment of inertia of the liquid are presented for both a very large coefficient of viscosity and a normal coefficient of viscosity. An equation for the velocity ratio is derived and velocity ratio profiles are presented. A comparison of the analytical and experimental effective moment of inertia ratios shows good agreement. Author

N66-33454*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EXPERIMENTAL ROCKET PERFORMANCE OF APOLLO STORABLE PROPELLANTS IN ENGINES WITH LARGE AREA RATIO NOZZLES

Carl A. Aukerman and Arthur M. Trout Washington, NASA, Aug. 1966 45 p refs

(NASA-TN-D-3568) CFSTI: HC $2.00/MF $0.50 CSCL 21I

The performance of nitrogen tetroxide and a blend of 50% hydrazine and 50% unsymmetrical dimethyl hydrazine was evaluated at a chamber pressure of 100 lb/sq in. absolute in rocket engines with large area ratio nozzles which produced 8000 to 9000 lb. of thrust. Two contoured nozzles with area ratios of 60 to 40 plus a 15° conical nozzle with an area ratio of 60 were operated at mixture ratios between 1.4 and 2.2. Tests were also run with 1.3-area-ratio nozzles to determine the most reliable and accurate method of separating internal performance between the combustion chamber and supersonic nozzle. Improvement of nozzle performance was attempted by injecting a catalytic fluid and analytically by recontouring the supersonic portion. The maximum delivered vacuum impulse at a mixture ratio of 2.0 was 320 sec for the conical nozzle and 318 for the scaled Apollo Service Module nozzle with an area ratio of 60. Experimental thrust coefficients indicated that some equilibrium flow existed and the net value could be predicted by aerodynamic and chemical reaction kinetic analysis. Nozzle performance was unaffected by characteristic velocity variations and combustion instability. The attempts to improve performance were unsuccessful. Pressure measurements in the combustion chamber were very unreliable in calculating chamber or nozzle performance. Impulse measurements with a low area ratio nozzle to calculate c^* efficiency was the most reliable and accurate method. Author

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N66-32923*# Rocketdyne, Canoga Park, Calif. Research Dept.
FLUORINE-HYDROGEN PERFORMANCE EVALUATION. PHASE I, PART I: ANALYSIS, DESIGN, AND DEMONSTRATION OF HIGH PERFORMANCE INJECTORS FOR THE LIQUID FLUORINE-GASEOUS HYDROGEN COMBINATION
Final Report
H. A. Arbit and S. D. Clapp Aug. 1966 224 p refs
(Contract NASw-1229)
(NASA-CR-54978; R-6636-1) CFSTI: HC $3.75/MF $1.25 CSCL 21H

Two injectors were designed for use with an uncooled, segmented, calorimetric thrust chamber (L^*=30-inches) designed for 2500-pound thrust (vacuum, ϵ=60) at the midpoint of the experimental matrix (chamber pressure=100 psia, mixture ratio=12). One was a triplet pattern in which LF_2 doublets impinged upon a central showerhead GH_2 jet; and the other employed self-impinging LF_2 doublets, with showerhead GH_2 jets on each side of the spray fan. Particular attention was given to the procedures used to obtain the experimental data, and analyses were presented covering their reliability and precision. Redundant measurements were made of all important parameters and characteristic velocity was calculated by two independent methods, one based on chamber pressure and the other on thrust. The performance of both injectors are discussed in terms of the degree of liquid atomization which they produce. Heat transfer results are considered in terms of the relative magnitudes of the three sources of chamber wall heat flux: convection, radiation, and recombination. C.T.C.

N66-33152# Library of Congress, Washington, D. C. Aerospace Technology Div.
TURBOFAN ENGINES—THEIR PRESENT AND FUTURE
Surveys of Foreign Scientific and Technical Literature
Andrew V. Valiunas 18 Apr. 1966 20 p Transl. into ENGLISH from Aviats. i Kosmonavt. (Moscow), no. 12, 1965, p 65–71
(ATD-66-42)

This translation was prepared from an article originally published as follows: Starostin, V. (Lt. Col., Engineer) Turbofan engines—their present and future Aviatsiya i kosmonavtika, no. 12, 1965, 65-71. The article describes a way of making turbofan engines by the use of well-designed turbojet engines and discusses the efficiency of such a conversion. The use of an afterburner in a turbofan engine, permitting the use of these engines at high supersonic flight speeds, is also discussed. The author cites specific English and American aircraft now using turbofan engines. A diagram of the X353-5 turbofan engine with a high by-pass ratio is shown; this engine is intended for the XV-5A VERTOL airplane. Turbofan engines with afterburners are being mounted in test aircraft. The author discusses performance of such engines. Future tactical aircraft and the type of engine required for their missions are described. Replacing of kerosene with liquid hydrogen is considered. The importance of reducing the weight of engines in order to increase the capability of airplanes is stressed. There were no references. Author

N66-33230# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AIR-CUSHION TRANSPORTS Selected Articles
S. A. Adasinskiy 31 Jan. 1966 56 p refs Transl. into ENGLISH from Transp. Mashiny na Vozdushnoy Podushke (Moscow), 1964 p 23–43, 79–102, 107
(FTD-MT-65-564; AD-633698) CFSTI: HC $3.00/MF $0.75

Contents: Horizontal motion, creation of thrust, and control; dimensions and structural forming; Soviet air-cushion machines; certain questions of theory; problems of further improvement; wheelless train on an air lubricant; place of flying machines among other forms of transport economic effectiveness. Author (TAB)

N66-33332*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INVESTIGATION OF SMALL-SCALE HYDRAZINE-FLUORINE INJECTORS
R. James Rollbuhler and William A. Tomazic Washington, NASA, Jan. 1959 17 p refs
(NASA-MEMO-1-23-59E) CFSTI: HC $1.00/MF $0.50 CSCL 21H (Declassified)

The performance of the liquid-hydrazine–liquid-fluorine propellant combination was investigated in nominal-300-pound-thrust uncooled rocket engines with different injectors. Data are presented for characteristic velocity as a function of weight percent fuel flow. All tests were made at a chamber pressure of 300 pounds per square inch absolute. The injectors, showerehead, like-on-like, and triplet types, were made of individual elements which could be used as "building blocks" in fabricating larger thrust injectors. The highest performance was obtained with triplet injectors. A maximum characteristic velocity of 6690 feet per second (94 percent of theoretical equilibrium) was reached at 36 weight percent fuel flow. In none of the runs was there any corrosion or erosion of the injectors, either from the propellants or combustion heat flux. There was no problem from hydrazine decomposition, propellant ignition, or combustion oscillation. Author

N66-33333*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INVESTIGATION OF INJECTORS FOR A LOW-CHAMBER-PRESSURE HYDROGEN-FLUORINE ROCKET ENGINE
Harold G. Price, Jr., Robert J. Lubick, and Arthur M. Shinn, Jr. Washington, NASA, Jul. 1962 30 p refs
(NASA-TM-X-485) CFSTI: HC $2.00/MF $0.50 CSCL 21H (Declassified)

Characteristic velocity efficiencies as high as 99 percent were obtained with gaseous hydrogen and liquid fluorine in short combustion chambers with a throat area of 12 sq in. Data covered a combustion-pressure range of 20 to 60 lb/sq in. abs (nominally 333 to 1000 lb thrust) and a fuel-by-weight range of 6 to 12 percent. Low-pressure-drop coaxial and shower-heat injectors were used; the best over-all results were obtained with a coaxial injector having five injector elements per sq in. of face area. Changing the number of injection elements, the chamber length, or the degree of propellant mixing affected performance. Some low-frequency combustion instabilities were observed which were believed to be associated with the flow system characteristics. Author

N66-33341*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE EVALUATION OF A TWO-STAGE TURBINE DESIGNED FOR A RATIO OF BLADE SPEED TO JET SPEED OF 0.146

Milton G. Kofskey Washington, NASA, Jan. 1960 39 p refs
(NASA-TM-X-146) CFSTI: HC $2.00/MF $0.50 CSCL 21E
(Declassified)

The design and experimental investigation of a two-stage turbine with low ratio of blade speed to jet speed, suitable for bleed-type high-energy liquid-rocket applications, are presented. First-stage and two-stage performance are described for operation with the first-stage rotor shrouded and unshrouded. With the exception of the final test, the equivalent weight flow was 15.3 percent greater than design value. Author

N66-33342*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL PERFORMANCE OF LIQUID HYDROGEN AND LIQUID FLUORINE IN REGENERATIVELY COOLED ROCKET ENGINES
H. W. Douglass, G. Hennings, and H. G. Price, Jr. Washington, NASA, Nov. 1959 57 p refs
(NASA-TM-X-87) CFSTI: HC $2.00/MF $0.50 CSCL 21H
(Declassified)

The rocket propellant combination hydrogen–fluorine gave very high performance efficiency (98 percent) when burned in a 5000-pound-thrust rocket engine at a combustion pressure of 300 lb/sq in. abs. Regenerative cooling with hydrogen was successful. No problems were apparent relative to engine operation, starting, or combustion stability. Author

N66-33344*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTS WITH HYDROGEN AND OXYGEN IN REGENERATIVE ENGINES AT CHAMBER PRESSURES FROM 100 TO 300 POUNDS PER SQUARE INCH ABSOLUTE
William A. Tomazic, Edward R. Bartoo, and R. James Rollbuhler Washington, NASA, Apr. 1960 39 p refs
(NASA-TM-X-253) CFSTI: HC $2.00/MF $0.50 CSCL 21H
(Declassified)

Tests were made with hydrogen and oxygen in regenerative thrust chambers of lightweight construction designed to give 20,000-pound thrust at a chamber pressure of 300 lb/sq in. abs and sea-level exhaust. Showerhead type injectors were used. Data were obtained at chamber pressures of 300, 150, 125, and 100 lb/sq in. abs over a mixture range from 10 to 23 percent fuel. Specific impulse for all pressures ranged from 93 to 98 percent of the theoretical for equilibrium expansion. The highest value obtained was 335 pound-seconds per pound at 300 lb/sq in. abs and 22 percent fuel. Average overall heat-transfer rates varied from 2.0 to 6.3 Btu/(sq in.)(sec) and closely matched calculated values. The experiments totaled 13 minutes of operation with chambers constructed of stamped channels which were brazed and wrapped with wire. Damage to the inner walls was experienced only during runs at 300 lb/sq in. abs. Low-frequency oscillations (approx. 100 cps) were obtained during operation at 100 to 150 lb/sq in. abs. These oscillations did not cause chamber damage. Author

N66-33346*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PRELIMINARY INVESTIGATION OF OFF-DESIGN PERFORMANCE OF DIVERGENT-EJECTOR-TYPE ROCKET NOZZLES
Laurence W. Gertsma and Richard A. Yeager Washington, NASA, Mar. 1960 49 p refs
(NASA-TM-X-250) CFSTI: HC $2.00/MF $0.50 CSCL 21H
(Declassified)

Ejector nozzles with a design pressure ratio of 361 were operated in a Mach 2.0 airstream with resulting ratio of jet total pressure to base static pressure ranging up to 165. With small amounts of secondary air flow, ejector wall pressure distributions indicated that overexpansion of the primary flow was prevented. A comparison between an ejector with bell nozzle and a typical convergent–divergent nozzle over a ballistic flight path indicated the ejector average thrust was always higher than that of the convergent–divergent nozzle. When the convergent–divergent nozzle thrust was corrected for base drag, the ejector average thrust was 3.4 percent higher than that of the convergent–divergent nozzle at the end of 130 seconds. Author

N66-33348*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL PERFORMANCE OF A HYDROGEN-FLUORINE ROCKET ENGINE AT SEVERAL CHAMBER PRESSURES AND EXHAUST NOZZLE EXPANSION AREA RATIOS
William L. Jones, Carl A. Aukerman, and John W. Gibb Washington, NASA, Oct. 1960 39 p refs
(NASA-TM-X-387) CFSTI: HC $2.00/MF $0.50 CSCL 21H
(Declassified)

The performance of a nominal-5000-pound-thrust hydrogen-fluorine rocket engine was evaluated over a range of mixtures from 6 to 20 percent fuel at chamber pressures from 60 to 725 pounds per square inch absolute with exhaust-nozzle area ratios of 3.7, 25, and 100. Performance near the theoretical maximum (97 percent) and stable combustion were obtained down to a chamber pressure of 60 pounds per square inch absolute at mixtures between 10 and 20 percent fuel. Performance in all cases dropped off for mixtures below about 10 percent fuel. Author

N66-33463*# General Electric Co., Philadelphia, Pa.
NAVIGATOR STUDY OF ELECTRIC PROPULSION FOR UNMANNED SCIENTIFIC MISSIONS. CONSTANT POWER MISSION ANALYSIS
H. Brown and J. R. Taylor Washington, NASA, Aug. 1966 45 p refs
(Contract NAS3-2533)
(NASA-CR-565) CFSTI: HC $2.00/MF $0.50 CSCL 21C

Electric propulsion requirements for unmanned single burn low thrust orbiter missions to all the planets in the solar system and flyby missions to Saturn, Uranus, Neptune, and Pluto were considered. Optimum requirements for maximizing payload capabilities at constant trip time for each individual mission were determined at specific power levels of 100, 160, 240, and 320, assuming the Navigator vehicle to be boosted by a multistage Saturn V booster. The flyby missions were restricted to a propulsion time of 10,000 hr, but time was varied for the major planet orbiters to optimize the Saturn V booster requirements. The essential features of the correlation technique used are described and the resulting propulsion requirements for each mission are given. It was found that the Venus and Mars orbiters did not require a booster as large as the Saturn V and that the Navigator power plant was underpowered for this booster; however, the Saturn V was felt to be suitable for the Mercury orbiter at the higher power levels. Trip times of about 4,200 hr with propulsion times of 3,400 hr were obtained with early technology; corresponding values with improved technology were 3,400 and 2,900 hr. L.E.W.

N66-33496*# Vickers, Inc., Troy, Mich. Research and Development Div.
ANALYTICAL AND EXPERIMENTAL STUDY OF ALTITUDE COMPENSATION OF A ROCKET BY SECONDARY INJECTION

Jul. 1966 98 p refs
(Contracts NAS1-4102; NAS1-2962)
(NASA-CR-66155) CFSTI: HC $2.50/MF $0.75 CSCL 21H

The mixing effects associated with supersonic injection into a supersonic main stream, and the feasibility of altitude compensation and thrust augmentation of an altitude rocket motor were studied. A secondary gas flow was unjected into the 37.5:1 area ratio nozzle of a subscale rocket motor. Both the primary and the secondary gases were at a nominal temperature of 2000°F. A theoretical model of the phenomenon was developed and two experimental evaluations were carried out under sea level conditions; the first utilized four injection ports and the second six ports. During the second test the flow of injected gas was modulated to determine the effects of varying the injected-to-primary flow ratio. The amount of nozzle pressure compensation and axial thrust augmentation was measured and compared with the theoretical predicted values. The results were largely inconclusive. Author

N66-33541*# Thiokol Chemical Corp., Elkton, Md.
DESIGN STUDY OF HEAT STERILIZABLE SOLID ROCKET MOTORS FOR SPACE APPLICATION, VOLUME I Final Report, Oct. 19, 1965–Jan. 9, 1966
27 Jun. 1966 275 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951405)
(NASA-CR-77065) CFSTI: HC $3.75/MF $1.50 CSCL 21H

Results are presented for a design and analysis study of heat sterilizable solid propellant rocket motors for space application. Candidate designs and detailed performance summaries are included. Problems associated with the design and subsequent dry heat sterilization of each motor system are identified. Author

N66-33606# Illinois Univ., Urbana. Charged Particle Research Lab.
CHARGED COLLOIDAL SIZED PARTICLES FOR PROPULSION Final Report, Nov. 1963–Nov. 1965
C. D. Hendricks Apr. 1966 13 p refs
(Grant AF-AFOSR-107-64)
(CPRL-3-66; AFOSR-66-0865; AD-632824) CFSTI: HC $1.00/MF $0.50

The report deals with parametric studies of the spraying of colloidal charged particles from a capillary. Both dc and ac sources were used. The main conclusion is that the thrust levels from colloidal systems are rising whereas the demands for thrust in many missions such as satellite attitude control, orbit maintenance, etc. are falling. The implication is that the colloid system shows more promise than it was originally believed to possess for use in such missions. Author (TAB)

N66-33616# General Electric Co., Cincinnati, Ohio.
LF-2 LIGHTWEIGHT LIFT FAN FRONT FRAME DESIGN
Ft. Eustis, Va., Army Aviation Mater. Lab., May 1966 106 p
(Contract DA-44-177-AMC-45(T))
(USAAVLABS-TR-66-12; AD-634104) CFSTI: HC $4.00/MF $1.00

The design, the manufacturing problems and their solutions, and the limited testing of a new bolted component assembled lightweight front frame for a tip turbine lift fan are discussed. This new frame was necessary for compatibility with a new lightweight improved critical speed response rotor design and to replace the present X353-5B front frame which is used in the General Electric Company's XV-5A Lift Fan Flight Research Program with a lighter weight and lower cost unit. The functions, description, design considerations, and stresses are discussed for each component. The frame component weights as calculated have been tabulated, and a comparison of the summation of the component calculated weights of 99.6 pounds versus the actual pan weight of 103 pounds is discussed. The frame was tested to 100-percent rotor speed loading as a component part of the LF-2 lift fan assembly. Limited operating data were obtained because of test termination resulting from turbine bucket shroud damage. Author (TAB)

N66-33659# Army Materials Research Agency, Watertown, Mass. Materials Engineering Div.
MECHANISMS OF EROSION OF TITANIUM BORONITRIDE ROCKET NOZZLES
Anthony K. Wong and James Brown May 1966 33 p refs
(AMRA-TR-66-12; AD-634136) CFSTI: HC $2.00/MF $0.50

Four rocket nozzles with throat diameters varying from 0.71 to 2.0 inches were fabricated from titanium boronitride compacts. This newly developed material was formed from titanium and boron nitride powders utilizing high compaction pressures and high reaction temperatures. Two compositions were investigated. Test firings of these nozzles were carried out in solid propellant static test rocket engines utilizing aluminized propellants with theoretical flame temperatures of 5500°, 5600°, and 5400°F. Post test analysis revealed the presence of cracks attributable to thermal shock and processing deficiencies. The erosion encountered varied from negligible to extremely severe. In the most severe case, the primary mechanism of erosion was established to be oxidation and conversion of the higher melting temperature constituents into a lower melting temperature oxide, followd by melting and removal from the nozzle contoured surface under the action of shearing stresses exerted by the hot flowing propellant exhaust gases. However, with the 5500° and 5600°F propellant, the mechanism of erosion was principally one of mechanical abrasion. Under limited conditions, a firmly supported titanium boronitride rocket nozzle may prove to be satisfactory. Author (TAB)

N66-33832# Navy Dept., Washington, D. C.
THE USE OF SINGLE-SHAFT AVIATION GAS-TURBINE ENGINES IN HYDROFOILS [PRIMENENIYE AVIATSIONNYKH ODNOVAL'NYKH GAZOTURBINNYKH DVIGATELEY NA DUSAKH S PODVODNYMI KRYL'YAMI]
P. A. Bulygin and G. S. Mineyev [1965] 8 p Transl. into ENGLISH from Sudostroyeniye (Moscow), Nov. 1965 p 35–38 *Its* Transl. No. 2136
(TT-66-61468; AD-634110) CFSTI: HC $1.00/MF $0.50

Single-shaft aviation TVD's (AI-20A and others) can be used successfully in SPKS without fundamental structural changes. Single-shaft aviation TVD's can be used in conjunction with controllable pitch aircraft type propellers, with controllable, or fixed, pitch propellers used for ships, or with a water-jet propeller. When production line single-shaft aviation TVD's are used as main engines the most suitable propeller for river ships is the water-jet propeller, which has a long life and makes the solution to the problem of reviving up the TVD during starting a comparatively simple one. Aviation GTD's run reliably on diesel fuel, as well as on kerosene, and all parameters remain virtually unchanged. The conversion of aviation single-shaft TVD's system for controlling rpm and power output, required when the engines are used with a water-jet propeller or a fixed pitch marine propeller and a hydraulic clutch, is very simple and reduces to taking out the governor and replacing the fuel pump with a fuel pump-governor. Author (TAB)

N66-34042*# Bell Aerosystems Co., Buffalo, N. Y.
PHOTOGRAPHIC INVESTIGATION OF PROPELLANT STREAM BEHAVIOR IN A FIRING ROCKET ENGINE, VOLUME I Technical Summary Report, 1 Aug. 1964–28 Feb. 1966
T. G. Rossmann, R. N. Eulner, and L. M. Wood 24 Jun. 1966 96 p refs *Its* Rept.-9136-950001
(Contract NAS8-11364)
(NASA-CR-77133) CFSTI: HC $3.00/MF $0.75 CSCL 21H

Results are presented of a photographic investigation to obtain injection and combustion patterns of injector elements of the F-1 rocket engine. A technique for installing and sealing windows of appreciable size, and protecting them against chemical and thermal attack by the combustion gases while keeping them sufficiently clean from deposits, was developed and proved satisfactory at chamber pressures up to 850 psia. Correlation between shadowgraphs of water sprays and shadowgraphs previously taken through a small firing experimental motor yielded basic information concerning the formation and internal structure of propellant sprays during firing conditions. Guidelines were established for the simulation of the injection and combustion patterns of a large thrust chamber in a model chamber small enough to permit application of high resolution shadow photography. Also established were guidelines for the selection and application of appropriate optical elements, light sources, and photographic equipment for taking high speed and high resolution photographs of combustion phenomena occurring in a windowed motor. ... C.T.C.

N66-34045*# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
TEMPERATURE AND DENSITY MEASUREMENTS IN THE BASE REGION OF A CLUSTERED ROCKET MODEL USING AN ELECTRON BEAM TECHNIQUE
J. Llinas and W. C. Rustay Jul. 1966 119 p refs
(Contract NSR-33-009-030)
(NASA-CR-77126; CAL-HM-2107-Y-2) CFSTI: HC $4.00/MF $1.00 CSCL 21H

The application of electron beam technology to the measurement of density and temperature in the complex-structured base region flow field of clustered-rocket engine configurations is discussed. A description is given of the apparatus designed to perform these measurements while installed within an altitude simulation tank operating at pressure altitudes of approximately 200,000 feet. Using short-duration testing techniques and shock-heated nitrogen as the model working fluid, base region density, temperature, pressure, heat-transfer and recovery temperature data were obtained for a 0.1 scale model of a four-engine Saturn booster stage. The feasibility of determining gas stream densities in the base region flow consisting of multi-specie rocket combustion gases with this technique is also discussed. A summary of the test results and recommendations for future studies are included. Author

N66-34051# Institute of Modern Languages, Inc., Washington, D. C.
EROSIVE ABRASION THEORY OF THE BLADE APPARATUS OF CENTRIPETAL TURBINES [K TEORII EROSIONNOGO ISNOSZA LOPATOCHNOGO APPARATA ZENTROSTREMITELINYCH TURBIN]
A. I. Loshkarev 1 Feb. 1966 22 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR (Moscow), no. 2, 1965 p 134–146
(Contract DA-44-009-AMC-1563(T))
(AERDL-T-1833-66; TT-66-61242; AD-632675) CFSTI: HC $1.00/MF $0.50

An investigation was made of the laws governing the motion of solid particles in the flow portion of a centripetal turbine; an evaluation was made of the particle sizes which do not bring about erosional abrasion and some design modifications leading to minimization of such abrasion are indicated. Author (TAB)

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N66-32793*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TIROS VII RADIATION DATA CATALOG AND USERS' MANUAL. VOL. 4: 1 OCTOBER 1964–19 JUNE 1965
15 Jan. 1966 305 p
(NASA-TM-X-57805) CFSTI: HC $4.25/MF $1.75 CSCL 04A

Radiometer performance and data, and satellite subpoint tracking charts are presented for Tiros VII. A continued degradation of the radiometer response was plotted in addition to the electronic degradation which was conclusively detected. Although the absolute values of the measurements are uncertain, degradation correction estimates are given for the interpretation of the data. Parameters and performance of the individual channels are discussed. Graphs are shown for periods of sunlight and shadow, orbital plane relationships, quasi-global equivalent blackbody temperatures and albedo, and temperature corrections. Data from 764 individual orbits are presented. The time intervals for which radiation data are available by means of subpoint tracks for each interrogation day are summarized. E.A.O.

N66-32970# Imperial Coll. of Science and Technology, London (England).
EFFECTS OF ELECTROMAGNETIC PERTURBATIONS ON PARTICLES TRAPPED IN THE RADIATION BELTS
J. W. Dungey *In* Intern. Atomic Energy Agency Plasma Phys. 1965 p 349–372 refs (See N66-32966 19-25) CFSTI: HC $9.79/MF $3.25

As the magnetic disturbances are weak compared with the undisturbed field, except near the outer boundary of the magnetosphere, it is pointed out that the disturbance can be treated as a perturbation and need only be calculated on the undisturbed trajectory of the particle. The adiabatic theory for describing this trajectory is summarized, and the adiabatic invariants and phase variables are tabulated. Formulas for obtaining numerical values are given. In determining the changes of the magnetic moment, only weak disturbances are considered, and it is assumed that the undisturbed field satisfies the condition for the adiabatic theory. Equations for characterizing waves in the magnetosphere are reviewed, as a basis for applying the results of the change in magnetic moment invariant to the radiation belts. Disturbances which change the longitudinal invariant are listed, and changes which affect the third invariant are considered. The form of the diffusion terms is examined, and an elementary method for deriving the Jacobian equation is explained. M.G.J.

N66-33188# Comision Nacional de Investigaciones Especiales, Buenos Aires (Argentina).
PROCEEDINGS OF THE REGIONAL SYMPOSIUM OF THE INTERNATIONAL YEARS OF THE QUIET SUN, VOLUME III

1965 138 p refs Symp. held in Buenos Aires, Aug. 1964 (Grant AF-AFOSR-716-65)
(CNIE-PE-9) CFSTI: HC $3.00/MF $1.00

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10. LOW ENERGY END OF THE PRIMARY PROTON, ALPHA PARTICLE AND HEAVIER NUCLEI SPECTRA W. R. Webber (Minn. Univ.) 16 p (See N66-33196 19-24)

N66-33187# Chile Univ., Santiago. Center of Cosmic Radiation.

SOME RESULTS ON THE ISOTOPIC COMPOSITION OF THE CARBON NUCLEI AND THE CHEMICAL COMPOSITION OF HIGH CHARGED NUCLEI OF THE PRIMARY COSMIC RAYS

G. Alviaj *In* Comision Nacl. de Invest. Espaciales Proc. of the Regional Symp. of the Intern. Years of the Quiet Sun, Vol. III 1965 7 p refs (See N66-33186 19-29) CFSTI: HC $4.00/MF $1.00

Isotopic composition data on the carbon nuclei, and chemical composition data on the high charged nuclei of primary cosmic radiation were obtained from a nuclear emulsion pack (composed of 200 plates of the Ilford G-5 type) exposed at altitudes varying from 6 g/cm^2 to 3 g/cm^2 above Minneapolis, Minn. for nearly 15 hrs. Electric charges of the primary nuclei were determined, and these data were then applied to separating the low charged isotopes of the primary cosmic rays. The atomic number of nuclei were determined by measuring either the density of small δ-rays or the mean free paths between them by a method previously outlined by the author. The computed δ-rays had a minimum energy of 10 KeV. Various track profiles of the nuclei studies are depicted, and the data are discussed. Other aspects of these investigations reported from the Center of Cosmic Radiation at the University of Chile are also discussed. L.S.

N66-33188# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

SOME RESULTS FROM THE IMP-1 GM COSMIC RAY DETECTOR

V. K. Balasubrahmanyan, G. H. Ludwig, F. B. Mac Donald, and R. A. R. Palmeira *In* Comision Nacl. de Invest. Espaciales Proc. of the Regional Symp. of the Intern. Years of the Quiet Sun, Vol. III 1965 11 p (See N66-33186 19-29) CFSTI: HC $4.00/MF $1.00

Results obtained with two mutually perpendicular GM telescopes on board the IMP-1 (Explorer XVIII) satellite are presented. It is shown that these results imply an anisotropic recovery of the cosmic ray intensity towards the maximum of the 11 year variation, the greatest modulation taking place in a direction close to the ecliptic poles. It is also shown that these results are consistent with the current views concerning the cavity that the solar wind produces in the inner solar system when it is slowed down and stopped by the galactic material. The omnidirectional intensity of particles with energies >40 Mev seems to suffer periodic fluctuations with period close to 12 hours. It is further shown that these fluctuations agree in amplitude and phase with similar fluctuations measured with the Deep River Super Neutron Monitor (the semi-diurnal variation). This suggests the existence of a mechanism capable of producing a true time variation in the cosmic ray intensity as seen by the satellite detector, and this mechanism could also explain the semi-diurnal variation measured with ground detectors. No explanation is offered for such mechanism. Author

N66-33189# Naval Research Lab., Washington, D. C. Nucleonics Div.

SPATIAL MODULATION OF PRIMARY COSMIC RAYS

B. Hildebrand and R. Silberberg *In* Comision Nacl. de Invest. Espaciales Proc. of the Regional Symp. of the Intern. Years of the Quiet Sun, Vol. III 1965 8 p refs (See N66-33186 19-29) CFSTI: HC $4.00/MF $1.00

The generic relationship between the energy spectra of a species of cosmic ray nuclei and their fragmentation products was used in a mathematical analysis which permits interpretation of the differences in the energy spectra of these species. The energy spectrum of the fragmented light elements (z=3,4, and 5), the medium elements (z=6,7,8,and 9), the heavy elements (z=10), and in particular the energy spectrum of He^3, which is taken to be largely produced by fragmentation of He^4 were studied. The analytical method, which is presented, yields information on the mean interstellar path length traversed by cosmic rays, the dependence of path length on energy, and the shape of the low energy local interstellar cosmic ray spectrum before it becomes distorted upon passage through the modulating fields of the solar system and the earth. A flow diagram depicting the spatial modulations of the He^3–He^4 intensities is given. Results of the analysis are discussed. L.S.

N66-33190# Naval Research Lab., Washington, D. C. Nucleonics Div.

HE^3 IN THE PRIMARY COSMIC RADIATION

B. Hildebrand, F. W. O'Dell, M. M. Shapiro, R. Silberberg, and B. Stiller *In* Comision Nacl. de Invest. Espaciales Proc. of the Regional Symp. of the Intern. Years of the Quiet Sun, Vol. III 1965 10 p refs (See N66-33186 19-29) CFSTI: HC $4.00/MF $1.00

Nuclear emulsion, and multiple scattering techniques were used in high altitude balloon particle tracking experiments designed to investigate the nature of primary cosmic radiation. The emulsions used were of relatively low sensitivity, and helium tracks in these emulsions were sufficiently thin so that the grains could be counted for estimating the ionization. In analyzing the data, two different procedures for estimating the ratio r of He^3/He^4-He^3 were used, and both showed substantial agreement. Gaussian fitted curves to the ionization parameter and coulomb scattering distributions of the particles tracked are depicted. A table showing the tracks sorted by energy/nucleon and rigidity intervals is given. The observed relative helium abundances in conjunction with other results are consistent with the assumption that fragmentation in space is the main source of He^3. The study of He^3-He^4 isotopic abundance is still being pursued, and continuing data from exposures should help resolve some of the present speculations on the sites of fragmentation and yield quantitative as well as qualitative information on the cosmic ray modulations. L.S.

N66-33389*# TRW Systems, Redondo Beach, Calif. Space Systems Lab.

WAVE-PARTICLE INTERACTIONS IN THE SOLAR WIND

Frederick L. Scarf 10 May 1966 47 p refs Presented at D.G.R.R. Symp. on Exploration of the Moon and Interplanetary Space, Munich, 22 Apr. 1966 Submitted for Publication
(Contract NASw-1366)
(NASA-CR-77043; TRW-4541-6003-RO-000) CFSTI: HC $2.00/MF $0.50 CSCL 20H

Recent fluid dynamic calculations which include thermal conduction viscosity and the rotating magnetic field of the sun appear to explain the transition from a nearly static corona to the supersonic solar wind, however the conventional fluid equations are not valid when the mean free paths become large. In interplanetary space the solar wind represents a collisionless magnetized plasma, and various plasma instabilities become significant as wave–particle interactions replace particle–particle scattering. The extent to which the interplanetary plasma can be considered a fluid is assessed using recent experimental data, the possible forms of local acceleration processes are discussed, and some classes of experiments which might help to understand these phenomena are described. Author

N66-33413*# California Inst. of Tech., Pasadena.

ACCELERATION OF ELECTRONS NEAR THE EARTH'S BOW SHOCK

J. R. Jokipii and Leverett Davis, Jr. Oct. 1964 9 p refs Submitted for Publication
(Grant NsG-426)
(NASA-CR-59559) CFSTI: HC $1.00/MF $0.50 CSCL 20H

An interpretation of the greater than 30 keV electrons found outside the magnetosphere near the earth's bow shock is presented. Rather than considering the structures where electrons are found as thin, relatively permanent and stationary layers in space, they are interpreted as regions transient in time and quite extended in space. They should occur typically every hour or so lasting a few minutes and blowing away with the solar wind. A wind velocity of 400 km/sec will move them 10^5 km (about the radius of the shock surface) in 4 minutes. Several models regarding the electron region are discussed. The authors suggest a mechanism which may accelerate particles in situations where a plasma containing a fluctuating magnetic field flows through a shock with high Mach number. Since the region outside the shock that is filled with energetic electrons depends on the direction of the field outside the shock, and the effectiveness of the trapping and accelerating mechanism depends on the kind of magnetic irregularities present, intercomparison of energetic electron and magnetometer observations should provide many tests for the models discussed. L.S.

N66-33419*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

THE SOLAR WIND AND ITS INTERACTION WITH THE MAGNETOSPHERE

Charles P. Sonett [1964] 46 p refs Submitted for Publication
(NASA-TM-X-54880) CFSTI: HC $2.00/MF $0.50 CSCL 04A

A short summary of the properties of the solar wind as they apply to the interaction process with the earth's magnetosphere is given. Necessary conditions on the bow shock are discussed and are compared to experimental evidence from several space probes. The importance of the downstream or post-shock flow is emphasized. Power spectra and details of the turbulence in this region are reviewed. Limitations due to the very preliminary status of Interplanetary Monitoring Platform data analysis are emphasized. Author

N66-33431*# Ling-Temco-Vought, Inc., Dallas, Tex. LTV Astronautics Div.

SOLAR ACTIVITY CATALOGUE. VOLUME I: CATALOGUE OF SOLAR ACTIVITY DURING 1954–1956

Fred C. Jonah, Helen Dodson-Prince, and E. Ruth Hedeman (Michigan Univ.) Houston, Tex., NASA. Manned Spacecraft Center, 26 Feb. 1965 176 p refs *Its* Rept.-00.594
(Contract NAS9-2469)
(NASA-CR-65217) CFSTI: HC $5.00/MF $1.25 CSCL 04A

The data compiled in this volume covers solar activity for the three years 1954–1956. This includes the year of solar minimum which occurred in April of 1954 and two years on the ascending branch of the solar cycle. The solar activity data is arranged in eight catalogs and includes major solar flares and related terrestrial effects, important sunspot groups, important plage regions, outstanding solar radio emissions, geomagnetic storms, important solar-terrestrial effects, balloon flights, and major solar events. R.N.A.

N66-33617# Travelers Research Center, Inc., Hartford, Conn.

SOLAR FLARE OCCURRENCE AS A FUNCTION OF SUNSPOT SIZE Scientific Report

Isadore Enger, Ronald T. Podsiadlo, Delos C. Jensen, and Fred Ward Bedford, Mass., AFCRL, Apr. 1966 25 p *Its* AF Surv. in Geophys. No. 178
(Contract AF 19(628)-5129)
(AFCRL-66-293; AD-634082) CFSTI: HC $1.00/MF $0.50

An objective technique has been developed for assessing the probability of occurrence of solar flares in a particular sunspot group, given only the sizes of the sunspot group on two consecutive days. The sunspot data cover the 10-year period 1955 to 1964 and have been published in the Greenwich Photoheliographic Results. The flare data were measured at Sacramento Peak, New Mexico. The flare and spot data were combined by a simple, objective technique which depends only on the size of the spot group and the relative positions of the spot group and flare. These results show the very marked dependence of flare occurrence on the size of the spot group and a significant, but very much smaller, dependence on the change in group size from one day to the next. Author (TAB)

N66-33691*# National Aeronautics and Space Administration, Washington, D. C.

SEARCH FOR HIGH-ENERGY PHOTONS FROM DISCRETE SOURCES OF COSMIC RADIATION [O POISKE FOTONOV VYSOKOY ENERGII OT DISKRETNYKH ISTOCHNIKOV KOSMICHESKOGO RADIOIZLUCHENIYA]

A. Ye. Chudakov, V. L. Dadykin, V. I. Zatsepin, and N. M. Nesterova Jun. 1966 11 p refs Transl. into ENGLISH of a paper presented at the 1st All-Union Conf. on the Invest. of Cosmic Rays from a Space Phys. Standpoint, Yakutsk, USSR, 23 Aug.–2 Sep. 1962

(NASA-TT-F-10190) CFSTI: HC $1.00/MF $0.50 CSCL 20H

An attempt was made to verify the hypothesis that the electrons observed in relatively high concentrations in numerous radio sources are the product of interaction of protons and high-energy nuclei with matter. The experiments aimed at detecting high-energy photons from the sources Cassiopeia A, Taurus A, Cygnus A, Virgo A, and several other, weaker radio sources. The method used was to record extensive air showers from the Cerenkov radiation produced by them in the Earth's atmosphere. No appreciable increase in count rate was observed for any of the sources; the observed photon flux did not exceed 10^{11} photons-cm^2/sec. This result contradicts the hypothesis that the electrons responsible for the synchrotron radiation for the Crab nebula originate from nuclear collisions. The largest increase in count rate was observed for Cygnus A in 1960 (1.6±0.8 percent); however, in 1961, the increase equaled only 0.68±0.28 percent. Author

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N66-32759*# Operations Research, Inc., Santa Monica, Calif.

OPTIMUM SECONDARY IMPULSE FOR INTERPLANETARY TRANSFERS Technical Note 64-21

P. R. Escobal 1 Jul. 1964 45 p refs

(Contract NAS8-5321)

(NASA-CR-76990) CFSTI: HC $2.00/MF $0.50 CSCL 22C

Exact analysis is developed with the aid of patched conic theory which permits determination of the optimum two-impulse velocity requirements for interplanetary transfers. Plane changes are accomplished by adding impulses normal to the instantaneous plane of motion. A single transcendental equation is developed in the relative inclination of the optimum orbital transfer planes. Solution of the transcendental equation will also yield the true anomaly difference from the departure terminal at which the secondary impulse is to be applied. Author

N66-32760*# Sandia Corp., Albuquerque, N. Mex. Planetary Quarantine Dept.

[SCOPE OF WORK FOR SCIENTIFIC AND TECHNICAL ASSISTANCE FOR THE PLANETARY QUARANTINE MISSION] First Quarterly Report, Period Ending Jun. 30, 1966

Jul. 1966 17 p ref

(NASA Order R-09-019-040)

(NASA-CR-76987) CFSTI: HC $1.00/MF $0.50 CSCL 22A

Continuing research, development, and engineering services in support of the planetary quarantine program are reported. Statistical models, based on planetary objectives, biological factors, and assembly and manufacture environments, are described. These models permit statistical predictions and analysis of microbiological contamination on planetary probes and landers. Areas of activity reported include: a general survey of program development, a modification of the Coleman–Sagan model, and a stochastic assembly model. Systems support activities discussed are a design for a high-rate aerosol particle sampler, study of fine particle behavior on surfaces, and assistance in clean room design and requirements. S.P.

N66-32944*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

ANALYSIS OF COMBINATIONS OF ALTITUDE AND DESCENT RATE FOR SAFE ABORT DURING TERMINAL PHASE OF LUNAR LANDING

Gary P. Beasley Washington, NASA, Aug. 1966 30 p refs

(NASA-TN-D-3525) CFSTI: HC $2.00/MF $0.50 CSCL 22A

An analytical study was conducted to determine the boundary curve of combinations of altitude and descent rate for which abort during the touchdown phase of a lunar landing is possible. The study determined the altitude required for a safe abort from the touchdown phase as a function of various parameters and operational considerations of the landing vehicle. These parameters included reaction attitude control power, abort (ascent) engine thrust, use of the attitude rockets for additional lift, and values at the start of abort of such quantities as pitch angle, pitch rate, and descent rate. The study established the minimum altitude threshold for aborting the landing based on these parameters, with consideration given to lags due to staging of the descent engine, pilot response, and engine firing delays. Only the first phase of the abort, that of arresting descent speed prior to touchdown, was considered. The results of the study indicate that a wide variation in the boundary curves can be obtained with variations in the assumed parameters. Also, if proper consideration is given to pitch angle at abort and to reaction-control and abort engine thrust levels, an abort capability can be provided throughout the entire touchdown phase. Author

N66-32945*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

ANALYSIS OF LUNAR AND SOLAR EFFECTS ON THE MOTION OF CLOSE EARTH SATELLITES

James P. Murphy and Theodore L. Felsentreger Washington, NASA, Aug. 1966 78 p refs

(NASA-TN-D-3559) CFSTI: HC $2.50/MF $0.75 CSCL 22A

Theoretical and experimental studies indicate that long periodic lunar and solar forces produce perturbations in the orbital elements of close earth satellites comparable to perturbations caused by the earth's oblateness. Analytic formulas for secular and long-period luni-solar gravitational perturbations, as well as long-period expressions for solar radiation pressure effects (neglecting the earth's shadow), are given. A program for computing luni-solar perturbations was written and it was used to analyze the motion of the Relay 1 (1962 B, Upsilon 1) and Telstar 2 (1963 13A) satellites. Author

N66-32956*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

LUNAR STRUCTURES AS DEDUCED FROM MUONG NONG TEKTITES

J. A. O'Keefe and I. Adler Washington, NASA, Aug. 1966 16 p refs
(NASA-TN-D-3564) CFSTI: HC $1.00/MF $0.50 CSCL 03B

From previous work, it is generally believed that tektites are derived either from terrestrial sedimentary rocks or from the moon. The Muong Nong tektites contain angular voids, an indication that they have never been completely melted. Microprobe studies of the voids indicate that they are chemically homogeneous, which seems to rule out the possibility of the tektites' having a terrestrial sedimentary origin and to indicate that they are from fragmental glass and of lunar origin. This conclusion is reinforced by Walter's discovery of coesite in tektites; it is interpreted in the light of theoretical studies of lunar ash flows, and the result is compared with the known lunar topography. Finally, the possibility that the lunar red spots may be lightning-generated during a small ash flow is noted. Author

N66-33016*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DETERMINATION OF ORBIT OF A SPACECRAFT WITH RESPECT TO AN OBJECT IN A KNOWN CIRCULAR ORBIT
Robert Scott Dunning Washington, NASA, Aug. 1966 47 p refs
(NASA-TN-D-3518) CFSTI: HC $2.00/MF $0.50 CSCL 22C

A set of second-order differential equations of motion for a body in a planetocentric orbit has been derived and solved with the use of a cylindrical shell coordinate system which describes the motion of an orbital vehicle as observed from another body in a known circular orbit about the planet. The solutions have been investigated for the specific case of a body in orbit about the moon. The results of the study indicate improvement in accuracy over first-order theory with no serious adverse sensitivity to initial conditions and with applicability over a wide range of flight conditions. Orbit prediction is accurate over relatively long trajectories with large spatial separation of the vehicles. Some parts of the study are applicable to a manual apogee and perigee prediction scheme. Author

N66-33100# Royal Greenwich Observatory, Herstmonceux (England).
FUNDAMENTAL DATA FOR SOUTHERN STARS (SIXTH LISTS)
David S. Evans 1966 23 p refs *Its* Bull. No. 110
CFSTI: HC $1.00/MF $0.50

New determinations of radial velocity, magnitude, color and spectral type for 200 southern stars are presented. Included in this list are nine subdwarfs and a number of nearby stars, eight of which have no trigonometric parallax determination but appear from photometric determinations to be within 20 parsecs of the Sun. Space coordinates and velocities relative to the Sun have been computed for 46 of them which are main-sequence stars later than F3. Observations of the 12 standard radial-velocity stars are reviewed and some of the difficulties in estimating spectral types discussed. The problem of how far the sample of subdwarfs contained in this and similar lists is subject to selection effects is also briefly considered. Author

N66-33113# Royal Greenwich Observatory, Herstmonceux (England).
PROPER MOTIONS IN THE FIELD OF NGC 6522
S. V. M. Clube London, HMSO, 1966 36 p refs Roy. Obs. Bull. No. 111
HMSO: 5s

The relative proper motions of 248 stars in and around NGC 6522 have been determined from two Mount Wilson 100-inch plate-pairs with a base line of 17 years. A partial segregation of cluster members from field stars has been achieved, and the color-magnitude diagram of the brighter members of the cluster ascertained. The field stars have been divided into a group of red giants in the nuclear bulge of the galaxy and a group of foreground main-sequence stars. Within the errors associated with this investigation, the relative proper motion of these groups of field stars turns out to be consistent with the pattern of circular velocities derived from 21-cm observations. The cluster's motion is direct and slightly inclined to the plane, but its translational kinetic energy is insufficient to take it far from the galactic center (i.e. within 2 kpc). An estimate of the circular velocity about 1 kpc from the galactic center has been made from the observed velocity dispersion of the field stars. Author

N66-33121# Royal Greenwich Observatory, Herstmonceux (England).
TIME AND LATITUDE SERVICE 1965, APRIL–JUNE
R. v. d. R. Woolley London, HMSO, 1966 23 p refs Roy. Obs. Bull. no. 113
HMSO: 3s

Tabulations of star time and latitude observations, and reception times of international radio time signals are presented. These observations were made at Herstmonceux, England, and cover the time period of April to June, 1965. C.T.C.

N66-33137# Royal Greenwich Observatory, Herstmonceux (England).
PHOTOELECTRIC PHOTOMETRY OF RR LYRAE STARS
D. H. P. Jones 1966 21 p refs *Its* Bull. No. 112
CFSTI: HC $1.00/MF $0.50

Light curves are presented in U,B,V for SS Pisciu, AH Camelopardi and UY Camelopardi and in B and V for TT Lyncis, RY Comae and AV Pegasi. AH Camelopardi is heavily reddened with $E_{B-V}=0^{m}.6$. None of the stars observed in U shows the brief U-B excess on the rising branch. Author

N66-33169*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LUNAR DIFFERENTIATION PROCESSES
Louis S. Walter [1964] 21 p refs Submitted for Publication
(NASA-TM-X-54903) CFSTI: HC $1.00/MF $0.50 CSCL 03B

This discussion begins with the assumption that the buildup of radiogenic heat in the moon has resulted in ubiquitous magma generation. Such igneous activity should have occurred sporadically over the lunar surface resulting in the differentiation of a lunar crust. The differentiation concentrated the radioisotopes in the more acidic crustal fraction which tended to increase the surface volcanic activity and further degassed and dehydrated the surficial rocks. However, loss of volatiles had the opposite effect of decreasing magma generation. The lack of water and sedimentary recycling may be why the moon is a cold body since volcanic activity may have been greatly curtailed in the recent selenological past. The products of the most recent stages of lunar magma generation are dealt with. Three factors affecting terrestrial magmatic trends, studied in the laboratory and in the field, are discussed in terms of their effect on lunar differentiation trends. Two factors, the lower pressure gradient with depth and the supposed water deficiency of the moon, would tend to cause lunar magmas to be acidic or silica rich. An extremely low abundance or fugacity of oxygen would tend to have the same effect. R.N.A.

N66-33182*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
A REVIEW OF NUCLEAR ENERGY GENERATION IN STARS, AND SOME ASPECTS OF NUCLEOSYNTHESIS
Hubert Reeves Sep. 1964 105 p refs Submitted for Publication
(NASA-TM-X-54921) CFSTI: HC $4.00/MF $0.75 CSCL 03B

Formulas are presented for the energy generation rate for each stage of stellar evolution. The uncertainties attached to each formula and which results from the nuclear physics aspects of the problem and from possible variations in the chemical composition of the reacting material are discussed. An attempt is made to evaluate the size of errors introduced in the analysis of stellar evolution when some minor nuclear reactions are neglected. Because nuclear reactions produce new elements which may themselves become fuel at high temperature, consideration is given to some aspects of nucleosynthesis. R.N.A.

N66-33195# Hawaii Inst. of Geophysics, Honolulu.
THE LIGHT OF THE NIGHT SKY: ASTRONOMICAL, INTERPLANETARY AND GEOPHYSICAL
F. E. Roach *In* Comision Nacl. de Invest. Espaciales Proc. of the Regional Symp. of the Intern. Years of the Quiet Sun, Vol. III 1965 27 p refs (See N66-33186 19-29) CFSTI: HC $4.00/MF $1.00

The intensity of visual radiation at various locations in the universe is discussed. Integrated nebular light as it would be seen by the human eye in intergalactic, interstellar, and interplanetary space and on the earth; integrated starlight as it would be seen in interstellar, and interplanetary space and on the earth; zodiacal light as would be seen in interplanetary space and on the earth; and night airglow as seen from the earth are discussed. The surface brightness of the night sky proceeding from the intergalactic to interstellar to interplanetary space and then to the earth's surface were examined in the 5300 Å spectral region near the center of the visual sensitivity curve. Data are presented in both tabular and graphic form, and are analytically interpreted. The general results are presented in a series of curves which portray the resolution of the night sky light into its three principal components (variation of component intensity with sidereal time); and in a logarithmic scale graphical representation of the brightness of components and features of the day and the night sky. L.S.

N66-33261# North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
ORBIT DIFFERENTIAL CORRECTION—TRACKING PROGRAM VOLUME I: DIFFERENTIAL CORRECTION GEOCENTRIC ORBIT COMPUTATIONS PROGRAM Final Report
George E. Townsend Griffiss AFB, N. Y., RADC, Apr. 1966 577 p ref
(Contract AF 30(602)-3638)
(SID-65-1203-1; RADC-TR-66-67; Vol. I; AD-633720) CFSTI: HC $8.75/MF $2.50

This document presents the formulation, computational logic and coding information developed for the purpose of effecting the definition of geocentric satellite orbits. The rationale for this process is constructed around the recursive minimum variance data filter developed by R. E. Kalman and a specially prepared magnetic tape generated in the preprocessor. The trajectory portion of the program is formulated in the Encke manner and includes perturbing accelerations resulting from the first 3 harmonics of the earth's potential function, atmospheric drag, solar radiation pressure, and solar and lunar gravitation. These accelerations are integrated via an uncorrected Gauss–Jackson routine started with a fourth order Runge–Kutta process. Author (TAB)

N66-33368*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
EFFECT OF NON-SYNCHRONOUS ROTATION ON CLOSE BINARY STARS
Su-shu Huang [1964] 10 p refs Submitted for Publication
(NASA-TM-X-54937) CFSTI: HC $1.00/MF $0.50 CSCL 03A

The effect of non-synchronous rotation of the component star in close binaries on its limiting surface is analyzed and the difficulties in the previous investigations are examined. It has been shown that no potential function exists in a coordinate system following the axial (non-synchronous) rotation of the component star. Consequently, no equilibrium surfaces can be obtained in this way. It is therefore suggested that we should retain the conventional coordinate system that rotates with the binary motion. Since a simple energy integral exists in this coordinate system, we can obtain a physical picture for the problem of the non-synchronously rotating star in the binary systems. Indeed we have found that the non-synchronously rotating star will modify its rotation gradually and become eventually synchronous with its orbital revolution. Author

N66-33371*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
ON THE GENERAL PERTURBATIONS OF THE POSITION VECTORS OF A PLANETARY SYSTEM
Peter Musen [1963] 31 p refs Submitted for Publication
(NASA-TM-X-54853) CFSTI: HC $2.00/MF $0.50 CSCL 03A

In this article a theory of the general perturbations of a planetary system is developed. The perturbations of the position vectors of each planet are expanded into series arranged in powers and products of the masses m_1, m_2, ..., m_n of the planets constituting the system. Perturbations of different orders are obtained in the form of series containing the purely periodic, the secular and the mixed terms, in accordance with standard astronomical practice. The influence of the lower order perturbations on the higher order ones is determined. Typical differential equations are formed determining those perturbations of the i^{th} planet which are proportional to m_k, $m_k m_p$, $m_k m_p m_s$, ... Decomposing each perturbation of any particular planet m_i along the undisturbed position vector $\vec{r}_i$ along the undisturbed velocity $\vec{v}_i$ and along the unit vector R_i normal to the undisturbed orbital plane, we deduce the differential equations to a form easily integrable by quadratures. The problem of the constants of integration is treated for the case of the elements osculating at the initial moment and for the case of the mean elements. Author

N66-33379*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
DYNAMICS AND EVOLUTION OF CLOSE BINARY SYSTEMS
Su-shu Huang [1964] 100 p refs Submitted for Publication
(NASA-TM-X-54930) CFSTI: HC $3.00/MF $0.75 CSCL 03B

This review on the dynamics and evolution of close binary star systems combines observational results in the form of light and velocity curves with predictions based on the dynamical principles of Newtonian mechanics and other physical laws. Considered are the Roche model and the related problem of mass overflow from the stellar surface, the mass motion resulting from this overflow, the evolution of single stars, and the origin and evolution of close binary stars. Only those binary star systems are considered that undergo eclipse

and that have at least a separation of 10 times the mean radius of the two component stars at its closest. G.G.

N66-33394*# Harvard Coll. Observatory, Cambridge, Mass.
DATA PROCESSING OF LUNAR INFRARED MEASUREMENTS AT HIGH SPATIAL AND RADIOMETRIC RESOLUTION TO OBTAIN BRIGHTNESS TEMPERATURE Scientific Report No. 9
Hector C. Ingrao, Andrew T. Young, Mary F. C. Leyland, Yung C. Hu, Elgie G. Levin et al 1 Jun. 1966 101 p refs
(Grant NsG-64-60)
(NASA-CR-77004) CFSTI: HC $3.00/MF $0.75 CSCL 03A

A unique data processing of lunar infrared measurements at high spatial and radiometric resolution to obtain brightness temperature is presented. This system takes into account all the instrumental parameters and observing conditions, including amount of ozone, carbon dioxide, and precipitable water along the path. Possible drifts in the instrument or changes in the sky emittance are also handled by the system. Moreover, for each line of scan the accuracy in the location of the resolution element on the lunar disk is also given, taking into account systematic errors such as the differential atmospheric refraction between visible and infrared rays. Author

N66-33414*# California Univ., Berkeley. Space Sciences Lab.
THE BLUE HAZE OF MARS
Ann Palm 7 Dec. 1964 25 p refs Submitted for Publication *Its* Ser. No. 5, Issue No. 70
(Grant NsG 243-62)
(NASA-CR-59938) CFSTI: HC $1.00/MF $0.50 CSCL 03B

The extent of blue clearings is investigated as a function of the number of the meteor showers intersecting Mars' orbit, at 10° intervals of heliocentric longitude. A rank correlation method has been employed. The analysis indicates a small but statistically significant negative correlation between the extent of blue clearing and meteor shower activity. This result combined with the optical properties of the Martian atmosphere and the close resemblance between the characteristics of the blue haze and those of the terrestrial noctilucent clouds suggests that variable amounts of interplanetary dust are suspended in the Martian atmosphere and that the occasional clearings of the blue haze are caused by a diminishing influx of these dust particles. Author

N66-33425*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
STELLAR EVOLUTION: A SURVEY WITH ANALYTIC MODELS
Robert Stein [1964] 152 p refs Submitted for Publication
(NASA-TM-X-54861) CFSTI: HC $4.00/MF $1.00 CSCL 03B

The aim of this discussion is to reproduce the basic features of stellar structure and evolution (as found from accurate calculations) by purely analytic considerations in order to gain physical insight into the evolution of stars. We will not here attempt accurate calculations of structures and evolutionary tracks. First we discuss general properties of stellar structure and evolution. Then, analytic models are constructed for the early homogeneous and the advanced inhomogeneous stages of evolution. Author

N66-33437*# New York Univ., N. Y. Dept. of Meteorology and Oceanography.
PROJECT HIAM Informal Report, Dec. 1965–May 1966
Wayne E. Mc Govern [1966] 21 p refs
(Grant NsG-499)
(NASA-CR-77048) CFSTI: HC $1.00/MF $0.50 CSCL 01B

Progress is reported on a number of astrophysical and geophysical studies. They include the atmosphere of Mercury, the atmosphere of Mars, the ashen light emission from the dark side of Venus, the 26-month oscillation of ozone concentration, calculation of average single particle scattering functions for clouds and aerosols, calculation of the distribution of scattered radiation in a plane parallel atmosphere, heat budget of the earth, the earth's albedo, degradation of the Tiros VII radiometers, optical constants of ammonium sulfate and sulfuric acids, and atmospheric breaking waves. R.N.A.

N66-33503*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ORBITAL PREDICTION AND DIFFERENTIAL CORRECTION USING VINTI'S SPHEROIDAL THEORY FOR ARTIFICIAL SATELLITES
Harvey Walden May 1966 102 p refs
(NASA-TM-X-55550; X-543-66-283) CFSTI: HC $3.00/MF $0.75 CSCL 22C

The spheroidal theory developed by Vinti for determining the orbit of an artificial satellite of an oblate planet is presented in algorithmic form, in which empirically derived initial conditions are used to obtain the co-ordinate and velocity components of an unretarded satellite at any time. A differential orbit improvement method utilizing observational data is described. This method produces a mean set of orbital elements by an iterated least-squares fitting of the equations of condition. The results of preliminary applications of the orbit generator and differential correction of two artificial satellites of the Earth, through use of a high-speed digital electronic computer, is shown in tabular and graphical form. Author

N66-33528*# Israel Program for Scientific Translations, Ltd., Jerusalem.
PHYSICS OF THE MOON AND THE PLANETS
I. K. Koval', ed. 1966 116 p refs Transl. into ENGLISH of "Fizika Luny i Planet" Kiev, Naukova Dumka, 1964 Prepared for NASA and NSF
(NASA-TT-F-382; TT-66-51019) CFSTI: HC $4.00/MF $1.00 CSCL 03B

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N66-33527*# Israel Programs for Scientific Translations, Ltd., Jerusalem.

POLYCHROMATIC POLARIMETRY OF SOME LUNAR REGIONS

V. V. Avramchuk *In its* Phys. of the Moon and the Planets 1966 p 1–10 refs (See N66-33526 19-30) CFSTI: HC $4.00/MF $1.00

Umov's effect for fine dispersion media assumes that as the specific absorptivity (β) of the medium increases, the significance of higher order scattering is rapidly reduced. As β increases, the spectral composition and degree of polarization of reflected light will vary, if it is assumed that no regular phase interface exists; another effect exists in the presence of a phase interface, that is there is a variation of the intensity ratio for the light reflected directly from the interface and the light scattered by the dispersed medium. Polarization observations are reported for determining the optical characteristics of lunar material. A variation of degree of polarization with wavelength is found at phases +12° to +13°. The degree of positive polarization varies almost monotonically and increases sharply in the ultraviolet for Plato, Grimaldi, and Otto Struve. Tycho and Copernicus have a degree of polarization which varies negligibly with wavelength in the 420 to 600 mμ range and increases only in the ultraviolet. A formula is given to show the relationship between the maximum degree of polarization and the albedo in narrow spectral regions. M.W.R.

N66-33528*# Israel Program for Scientific Translations, Ltd., Jerusalem.

SPECTROPHOTOMETRY OF SOME LUNAR OBJECTS

M. N. Mironova *In its* Phys. of the Moon and the Planets 1966 p 11–22 refs (See N66-33526 19-30) CFSTI: HC $4.00/MF $1.00

Various lunar craters were studied by obtaining spectral brightness coefficients and comparing the spectra of various lunar objects. Examination of about 500 spectrograms revealed that no gas efflux was observed in the following craters: Alhazen, Alphonsus, Aristarchus, Arzachel, Herodotus, Hyginus, Linne, Messier, Plato, Schickard, and Tycho. Spectral brightness curves indicate that the surfaces of these craters are covered with rocks that have spectral characteristics like basalt tuff. Floor, central peak, and walls do not differ much in spectral reflectivity; the greatest difference observed was between the yellowness indices of the central floor and peak of Alphonsus. The surface of Aristarchus has rocks with a luminescent band similar to that of scheelite; this luminescence is attributed to ultraviolet radiation from the sun and solar corpuscular flow. M.W.R.

N66-33529*# Israel Program for Scientific Translations, Ltd., Jerusalem.

SPECTRAL STUDIES OF THE LUNAR SURFACE

A. N. Sergeeva *In its* Phys. of the Moon and the Planets 1966 p 23–33 refs (See N66-33526 19-30) CFSTI: HC $4.00/MF $1.00

More than 200 lunar features were observed from the processing of 56 spectrograms in order to detect color contrasts for these different features. At each wavelength, deviations were calculated of the intensities of these lunar features from the intensity of the standard area or from mean intensity of all lunar features. These results are presented in 15 tables, each of which gives the wavelengths of the microphotometric sections and the color shadings of the different lunar formations expressed as percentages of the intensity of the standard area. Four spectra appear on each table, and from two to seven lunar features are distinguishable in each spectrum. Relative intensity deviations range from less than 10% to 18%; and since these deviations are comparatively small, it is concluded that the actual color contrasts of the lunar features are too slight to be detected by photographic photometry. M.W.R.

N66-33530*# Israel Program for Scientific Translations, Ltd., Jerusalem.

ON THE STUDY OF THE OPTICAL PROPERTIES OF THE ATMOSPHERE AND SURFACE OF MARS

I. K. Koval' *In its* Phys. of the Moon and the Planets 1966 p 34–39 refs (See N66-33526 19-30) CFSTI: HC $4.00/MF $1.00

Following a review of various findings dealing with the surface of the moon, it is concluded that the distribution of energy in the visible spectrum of Mars and its color depend mainly on surface energy distribution. The surface of Mars may be regarded as covered by a powdered limonite which is orange in color; and the visual albedo of Mars and the albedo of the true surface may differ slightly from each other. During clear periods, fluctuations of the visual albedo in the violet region may not be noticed. The true continent-mare contrast at $\lambda = 400$ mμ is usually entirely blurred by an atmospheric veil produced by light scattering in the Martian atmosphere. In the 400 to 650 mμ range, the light is scattered in the same sense as Rayleigh scattering, so that toward lower wavelengths the rate of limb darkening of the apparent disk is more gradual. At even greater wavelengths, coarse particles float in the Martian atmosphere and result in a decrease in the limb darkening to the infrared. M.W.R.

N66-33531*# Israel Program for Scientific Translations, Ltd., Jerusalem

THE BRIGHTNESS DISTRIBUTION IN THE MARGINAL ZONE OF MARS

L. A. Bugaenko, O. I. Bugaenko, I. K. Koval', and A. V. Morozhenko *In its* Phys. of the Moon and the Planets 1966 p 40–42 refs (See N66-33526 19-30) CFSTI: HC $4.00/MF $1.00

Photoelectric cross sections of the planetary disk are used to measure the radial brightness distribution of Mars to obtain data on the brightness variation at the edge of the image and to increase accuracy of measurements. Observations, reported for the 1963 opposition of Mars, were made at the Cassegrain focus of a 70-cm reflector using light filters. Two photomultipliers served as radiation pick-ups and the recordings were made on a loop oscillograph. Since errors in such observations are mainly due to turbulent vibrations of the image, only those observations made under the most favorable conditions were processed. At 600 mμ variation of brightness with angle of incidence is close to a Lambert-type variation. For 355 mμ, the Martian atmosphere is considered to have considerable true absorption. It is concluded that the Martian atmosphere constantly carries scattering dust particles with radii of about one micron. For each wavelength from 420 mμ, the values of the visual albedo at the center of the disk are used to find the limb for various values. M.W.R.

N66-33532*# Israel Program for Scientific Translations, Ltd., Jerusalem.

RESULTS OF POLARIMETRIC OBSERVATIONS OF MARS IN 1962–1963

A. V. Morozhenko *In its* Phys. of the Moon and the Planets 1966 p 43–60 refs (See N66-33526 19-30) CFSTI: HC $4.00/MF $1.00

A literature survey is made relating to properties of light polarized via diffusion reflection from the Martian surface and scattering in its atmosphere, and results are reported for polarimetry studies conducted during the 1962–1963 opposition. The variation of polarization with phase angle for all Martian features is found to be close to that observed for the center of the disk. The spectral variation positive polarization for these features is less steep than for the center, however, in keeping with a difference in the spectral variation of apparent albedo. Polarization in the southern polar region is consistently less than in the northern region, apparently due to differences in structure. Degree of polarization is found to fluctuate widely from day to day. M.W.R.

N66-33533*# Israel Program for Scientific Translations, Ltd., Jerusalem.

DETERMINATION OF OPTICAL PARAMETERS OF THE ATMOSPHERE AND SURFACE OF MARS

A. V. Morozhenko and E. G. Yanovitskii *In its* Phys. of the Moon and the Planets 1966 p 61–68 refs (See N66-33526 19-30) CFSTI: HC $4.00/MF $1.00

The known brightness distribution of the Martian disk was used to determine the optical parameters of its atmosphere and surface from absolute photometric data. A computational procedure and related tables are given which enable the calculation of these optical parameters with relative ease and accuracy. It is assumed that the Martian highlands are orthotropically reflecting, that these parameters are constant for all scanned points of the highland from which the brightness distribution curve is plotted, and that the atmosphere of Mars does not absorb selectively in the entire range of wavelengths used in Martian photometry. In the 450 to 850 mμ range, the Martian atmosphere is purely scattering; below this true absorption is felt which increases with decreasing wavelength. During dust storms, the optical thickness of the Martian atmosphere in the infrared decreases with increasing wavelength because of the presence of coarse dust particles. M.W.R.

N66-33534*# Israel Program for Scientific Translations, Ltd., Jerusalem.

APPROXIMATE SOLUTION OF THE PROBLEM OF DIFFUSE REFLECTION AND TRANSMISSION OF LIGHT IN PLANETARY ATMOSPHERES WITH AN ARBITRARY SCATTERING INDICATRIX

E. G. Yanovitskii *In its* Phys. of the Moon and the Planets 1966 p 69–82 refs (See N66-33526 19-30) CFSTI: HC $4.00/MF $1.00

Approximate methods are considered for the solution of the equation of radiative transfer in planetary atmospheres, and formulas for brightness factors are derived by a method based on certain Chandrasekhar relations. Both a medium of infinite optical thickness and an atmosphere of finite optical thickness and an atmosphere of finite optical thickness are treated, with appropriate formulas evolved for each case. The accuracy of the formulas was estimated for a plane layer of finite optical thickness, and the resultant graphs indicate that the error in the calculations does not exceed 10% for the simplest nonspherical indicatrix. It is concluded that, in the majority of cases, this estimate applies also to brightness factors of the diffusely reflected and diffusely transmitted radiation. M.W.R.

N66-33535*# Israel Program for Scientific Translations, Ltd., Jerusalem.

DIRECT-READING RECORDING ELECTROPOLARIMETER OF THE MAIN ASTRONOMICAL OBSERVATORY OF THE ACADEMY OF SCIENCES OF THE UKRAINIAN SSR

O. I. Bugaenko *In its* Phys. of the Moon and the Planets 1966 p 83–93 refs (See N66-33526 19-30) CFSTI: HC $4.00/MF $1.00

A direct-recording electropolarimeter is described which permits the reliable recording of 0.1 to 0.2% polarization. The threshold stellar magnitude sensed by the polarimeter depends on the degree of polarization at the source; and for a source with P = 1%, the device will register a 10 st object. Absolute error of measurements is less than 1% for low polarizations, and 0.5% for high polarizations; and orientation of the polarization plane is measured to within ±0.5°. Block diagrams of the polarimeter and circuit diagrams of its various parts are included. M.W.R.

N66-33536*# Israel Program for Scientific Translations, Ltd., Jerusalem.

TYPES OF COMETARY TAILS

A. A. Demenko *In its* Phys. of the Moon and the Planets 1966 p 94–103 refs (See N66-33526 19-30) CFSTI: HC $4.00/MF $1.00

A catalog of 167 cometary tails is presented which lists new and old designations, type of tail, apparent and calculated maximum tail length, and source of information. For the classification according to types, the mean solar acceleration $(1 + \mu)$ is determined for which the curvature of the syndyname fits the median line of the tail; and for comets with large tails, a photograph or accurate drawing of the tail against the field of stars is used. Tails are listed according to one of three types according to the calculated value for $1+\mu$ or as anomalous. The latter group points toward the sun, generally leading the radius-vector of the comet. The types are those classified by Bredikhin who regarded the geometric elements of tails as syndynames and synchrones; a syndyname is a locus of idealized particles with the same acceleration escaping from the nucleus at different times; the synchrone's particles escape at the same time. M.W.R.

N66-33698*# National Aeronautics and Space Administration, Washington, D. C.

SELECTION OF PARAMETERS FOR A DYNAMIC SYSTEM UNIVERSAL FOR A GIVEN GROUP OF MANEUVERS [K VYBORU PARAMETROV DINAMICHESKOY SISTEMY, UNIVERSAL'NOY DLYA ZADANNOGO KLASSA MANEVROV]

V. V. Tokarev May 1966 25 p ref Transl. into ENGLISH from Russian

(NASA-TT-F-10133) CFSTI: HC $1.00/MF $0.50 CSCL 22A

The problem of using a given number of maneuvers by a given number of system types less than the number of maneuvers is stated. The value of the initial functional, averaged on the base of all maneuvers, is a criterion of optimization, and distribution of the required number of accomplished maneuvers according to their parameters is known. An alternative statement of the universalization of optimum parameters for the dynamic system is considered. It is assumed that the system may consist of separate modules. The problem is stated of the selection of optimum parameters for a module, universal for all given maneuvers, and of optimum number of modules for each maneuver. Examples are considered for application to the problem of maximum payload delivery when a body of variable mass and restricted jet power moves in a gravitational field. It is shown that many maneuvers can be

accomplished with a little decrease of the averaged payload by means of one type of propulsion system; two types practically eliminate the decrease. When a universal module is used, the sacrifice is equally small for different changes of maneuver parameters. Author

N66-33707# Joint Publications Research Service, Washington, D. C.
SOVIET-BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO. 138
16 Aug. 1966 92 p refs
(JPRS-37058; TT-61-11147-138) CFSTI: $3.00

The review of astronomy includes stellar spectra, solar activity, the Venus and Mars atmospheres, and a new observatory; abstracts treat interplanetary dust, and solar and cosmic models and observations. Listed under meteorology are hydrometeorological activities, and atmospheric conditions; the abstracts cover atmospheric turbulences, movements, temperatures, and densities; and include radar echoing, and methods of forecasting. Oceanography covers vertical motions in the ocean, and computer application; abstracts concern ocean currents and their characteristics. Arctic and Antarctic ice and tides, sonic signals in the ocean, and research methods and equipment. Terrestrial geophysics lists crust and mantle studies, gravity measurements, and electronic prospecting; earth structures and seismic phenomena and methods are covered in abstracts. Upper atmosphere and space research treats cloud and cosmic ray observations, spacecraft launchings and equipment, and East German activities; abstracts deal with particle, density, layer, and wave research. Soviet Arctic and Antarctic activities, a landslide warning system, and dealkalinization are also discussed. K.W.

N66-33770*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PLANETARY SPECTRA BY FOURIER SPECTROSCOPY. I: MARS
P. Connes and J. Connes 1 Aug. 1966 55 p ref
(Contract NAS7-100)
(NASA-CR-77116; JPL-TR-32-998) CFSTI: HC $2.50/MF $0.50 CSCL 03A

Mars spectra, obtained during the spring 1965 apparition by interferometric spectroscopy, are presented. A brief discussion is included, together with a summary of the format used to characterize the individual spectral traces. Tables, covering the observing conditions at the time the spectra were taken, are also included. Author

N66-33818# Cornell Univ., Ithaca, N. Y. Center for Radiophysics and Space Research.
MEASUREMENT OF SOLAR RADIATION AT 430 MEGACYCLES Quarterly Status Report, 1 Aug. 1965-30 Apr. 1966
Marshall H. Cohen May 1966 8 p
(Contract Nonr-401(27))
(CRSR-238; AD-633477) CFSTI: HC $1.00/MF $0.50

In an attempt to determine whether or not the characteristics of Type I solar storm radiation are due to scintillation, caused by the passage of radiation through the overlying irregular corona, a radio investigation of the statistics of these storms is planned. The investigation is to be carried out by digitally sampling the statistics of the scintillating signal at regular intervals, and then, from these data, computing the autocorrelation function and the power spectrum. D.T.

N66-33837# RAND Corp., Santa Monica, Calif.
PROCEDURES FOR ESTIMATING THE RESOURCE REQUIREMENTS OF MANNED SPACE FLIGHTS
Joseph String Jun. 1966 30 p Presented at the Spring Meeting of JSGOMRAM, Boston, 27 Apr. 1966
(P-3382; AD-634085) CFSTI: HC $2.00/MF $0.50

The paper is addressed to three principal topics: (1) what a typical manned space flight plan looks like; (2) procedures employed in evaluating the resource impact of alternative space flight proposals, either projects or plans; (3) the resource implications of some of the major types of activities currently being considered in NASA's long-range planning. TAB

N66-33862# Library of Congress, Washington, D. C. Aerospace Technology Div.
SURFACE CHARACTERISTICS OF THE MOON, MARS AND VENUS Annotated Bibliography, 1963-1966
Joseph Javis and Daniel W. Michaels 16 May 1966 74 p refs
(ATD-66-53)

This annotated bibliography was compiled from Soviet bloc open sources published 1963-1966 on the surface characteristics of Mars, Venus, and the Moon with reference to light polarization and albedo measurement techniques and to radioastronomical investigations. The 110 bibliographic entries are listed alphabetically by author in sections on The Moon, Mars, Venus, and General; and an author index is included. Other information deals with photography of celestial bodies, photogrammetry, and photointerpretation in space investigations; unusual formation on Venus; radar observations of Venus; Martian canals; Mars satellites; volcanic activity on Mars; colorimetric comparison of asteroids and terrestrial rocks. Author

N66-33966*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
COMPUTATIONAL PROCEDURE FOR VINTI'S ACCURATE REFERENCE ORBIT WITH INCLUSION OF THE THIRD ZONAL HARMONIC
N. L. Bonavito Washington, NASA, Aug. 1966 20 p refs
(NASA-TN-D-3562) CFSTI: HC $1.00/MF $0.50 CSCL 22C

Vinti has recently modified his spheroidal potential so as to permit exact inclusion of the effects of the third zonal harmonic of the planet's gravitational field. This corresponds to a potential fitted exactly through the third zonal harmonic and about two-thirds of the fourth. The present paper treats the method for obtaining the position and velocity coordinates of a satellite moving in the field corresponding to this accurate modified potential. Author

N66-33968*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
THE DRIFT OF AN INCLINED—ORBIT 24-HOUR SATELLITE IN AN EARTH GRAVITY FIELD THROUGH FOURTH ORDER
C. A. Wagner Washington, NASA, Aug. 1966 73 p refs
(NASA-TN-D-3316) CFSTI: HC $2.50/MF $0.75 CSCL 22C

This report extends previous investigations of 24-hour satellites by considering the long-term drift of such satellites with orbits having any inclination but small eccentricity in an earth gravity field through fourth order. It is demonstrated that the drift regime for the inclined-orbit satellite is the same as for the equatorial satellite, modified only by an inclination factor distinct for each relevant gravity harmonic and in each case less than unity for non-zero inclinations. In particular, it is shown that for the circular orbit satellite through fourth-order earth gravity, only the longitude gravity harmonics J_{22}, J_{31}, J_{33}, J_{42}, and J_{44} can have long-term (secular)

effects on the orbit. Except for very high inclinations, the 24-hour drift regime, as influenced by presently determined earth gravity, is dominated by the effect of the J_{22} harmonic (that associated with the ellipticity of the earth's equator). For the longitude gravity harmonics, J_{31} and J_{42}, certain "non-resonant" inclinations are shown to exist. Twenty-four-hour satellites having orbits with these inclinations will experience negligible long-term accelerated drift due to either J_{31} or J_{42}. Author

N66-33978*# National Aeronautics and Space Administration, Washington, D. C.
RELATIONSHIP OF THE ALBEDO OF VENUS TO WAVELENGTH IN THE ULTRAVIOLET BAND OF THE SPECTRUM
I. N. Glushneva Aug. 1966 11 p refs Transl. into ENGLISH from Astron. Inst. of Sternberg (USSR), no. 133, 1964 p 37–43
(NASA-TT-F-8798) CFSTI: HC $1.00/MF $0.50 CSCL 03B

Spectrograms of Venus were obtained during January and February 1963 for the purpose of determining the relationship of the albedo of Venus to the wavelength in the ultraviolet region ($\lambda\lambda$ 4,500-3,200 A) of the spectrum. The star α Lyr was used as a comparison body since its energy distribution in the spectrum has been thoroughly studied. It was found that the albedo of the planet decreases insignificantly with a diminution of the wavelength. These findings are contrary to data provided by Kozyrev in the literature. Either one or the other findings are erroneous, or the content of the unknown multi-atomic molecule picked up by the spectrograph changes with time. Another possible reason for the appearance of errors is the great difference in the exposure made while photographing the spectra of Venus and the sun. The relationship of the albedo of Venus to the wave length does agree well with the results of photometric studies made of Venus in the U, B, V system. Since the trend of the albedo in the visual region is the same as in the ultraviolet region, scattering in the Venutian atmosphere in these areas of the spectrum is caused by the same agent. L.S.

N66-33979*# Martin Co., Baltimore, Md.
STUDY OF LOCAL FLOW CONDITIONS OVER A HEMISPHERICALLY BLUNTED 25° CONE FOR A SHALLOW REENTRY TRAJECTORY
L. D. Wing and W. H. Eilertson Jan. 1966 29 p refs
(Contract NAS1-5253)
(NASA-CR-66046) CFSTI: HC $2.00/MF $0.50 CSCL 22C

A study has been made of the aerodynamic heating, wall shear stress and local flow field properties for a 25 degree half-angle conical vehicle with a 3 inch spherically blunted nose and a 30 inch diameter base entering the atmosphere in a zero-lift reentry trajectory. The initial conditions of reentry are: relative flight path angle of −4.29 degrees; relative velocity of 26,000 fps and initial altitude of 433,200 ft. A trajectory is presented for these reentry conditions with the vehicle angle of attack constant at zero degrees. In addition, the laminar and turbulent heat rate and wall shear stress histories, the local (external to the boundary layer) histories of density, temperature, enthalpy, pressure, viscosity, Mach number and Reynolds number (based on local properties and surface distance from the stagnation point) are presented for body stations: s/R_N (surface distance from stagnation point non-dimensionalized with nose radius) = 1.0, 2.25, 3.0, 4.0, 5.0 and 10.0. Author

N66-34007# Arizona Univ., Tucson. Steward Observatory.
ASTRONOMY, SPACE, AND THE MOON
W. G. Tifft [1966] 32 p
(T66-8)

The desirability of manned optical astronomy in space is considered and the advantages are outlined, e.g., elimination of atmospheric extinction which permits observation in the ultraviolet and infrared, elimination of atmospheric image blurring, and darkness of the sky. It is shown that on a cost-effectiveness basis a space telescope could cost 10^3 times its earth counterpart before its effectiveness in data yield is more costly, based on the assumption that man can effectively program and utilize 10^3 times more data. The role of man in space astronomy is outlined, and the three basic sites for space astronomy (i.e., low earth orbit below the Van Allen belts, high earth orbit outside the major radiation zones, and the lunar surfaces) are discussed in terms of economic, geometrical, environmental, and operational factors. Significant factors were tabulated, and it was concluded that the lunar site has definite possibilities and cannot be dismissed lightly. Finally, the lunar observatory is briefly described and its capabilities projected. L.E.W.

N66-34027# General Electric Co., Philadelphia, Pa. Missile and Space Div.
ON THE INTERNAL MAGNETIC FIELD OF THE SUN
K. T. Yen Jul. 1966 29 p refs
(R66SD39)

Analytical solutions for the internal magnetic field of the sun are presented. The solutions are based on the idea that the solar wind originates from the sun's interior. The magnetic field is assumed to be weak throughout the interior of the sun so that its effects on the general physical properties of the sun are small. The magnetogasdynamic equations are used to obtain the magnetic solutions. The general configuration of the magnetic lines given by the present solutions is found to be in agreement with that assumed by Babcock in his study of the sunspots and the 22-year solar cycle. A distinctive feature of the configuration is the presence of shallow submerged lines underneath the sun's surface. Author

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see 30 Space Sciences. For related information see also 28 Propulsion Systems; and 32 Structural Mechanics.

N66-32705*# Philco Corp., Palo Alto, Calif. Western Development Labs.
SOLAR PROBE STUDY. BOOK A, APPENDIX 2: MISSION ANALYSIS
30 Aug. 1963 76 p refs
(Contract NAS2-1397)
(NASA-CR-63841; WDL-TR2133) CFSTI: HC $3.00/MF $0.75 CSCL 22B

Results of the flight mechanics analyses for Atlas/Agena and Atlas/Centaur solar probe missions are given. Considered were: (1) booster system velocity, payload, perihelion, and inclination capabilities; (2) orbit velocity requirements for special perihelions and inclinations; (3) time histories of orbital parameters; (4) orbit errors caused by parking orbit perturbations, launch time, cutoff velocity, and solar orbit injection parameters; and (5) asteroid belt and comet probe secondary missions. G.G.

N66-32794*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
RANGE SAFETY DATA FOR SATURN SA-10
G. W. Solmon and E. L. Leonard 17 Jun. 1965 100 p refs *Its* Range Safety Data Rept.-4-65
(NASA-TM-X-57806) CFSTI: HC $2.50/MF $0.75 CSCL 22D

The data presented are for the Saturn SA-10 vehicle, with a firing azimuth of 95.2° east of true north, and is based on a standard trajectory. The data consists of booster and launch escape system impact areas, effects of range safety termination, land impact probabilities, injury probabilities, and turning rate effects. Graphs of turning rates and earth-fixed velocity as a function of time, after malfunction is introduced, are given for the S-I and S-IV stages. The iterative guidance was used in the second stages for the standard and $\pm 3\sigma$ dispersion trajectories. Author

N66-32955*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MEASURED PERFORMANCE OF WATER VAPOR JETS FOR SPACE VEHICLE ATTITUDE CONTROL SYSTEMS
Gerd Kanning Washington, NASA, Aug. 1966 27 p refs
(NASA-TN-D-3561) CFSTI: HC $1.00/MF $0.50 CSCL 22B

Measurements were made to evaluate the performance of water-vapor jets in the thrust range from 5 to 200 dynes. It was found necessary to reduce the ambient pressure to less than 1 micron to obtain results applicable to a space environment. Under these conditions, the steady-state specific impulse was 58 to 65 percent of the value expected for isentropic flow regardless of nozzle size. The specific impulse measured for a train of pulses was always found to be less than that for steady thrust. For pulses lasting 1/2 to 5 seconds, the measured specific impulse was 10 to 25 percent less than the steady-state value. Author

N66-33075*# Electro-Optical Systems, Inc., Pasadena, Calif.
INSTRUMENTS AND SPACECRAFT, OCTOBER 1957-MARCH 1965 Space Measurements Survey
Henry L. Richter, Jr., ed. Washington, NASA, 1966 1013 p refs Sponsored by NASA
(Contract DA-49-146-XZ-100)
(NASA-SP-3028) CFSTI: HC $6.00/MF $4.75 CSCL 22B

Characteristics of scientific instrumentation carried in orbital and deep space vehicles are summarized, along with pertinent characteristics of the spacecraft themselves. Spacecraft are listed chronologically by launch date. Data listed for each satellite and probe include the initial orbital parameters, the known scientific experiments and instruments, and details, when known, as to the data and power systems. Instruments are arranged by type, and descriptions, drawings, photographs, and other material are provided. E.A.O.

N66-33162# Royal Aircraft Establishment, Farnborough (England).
SPACE PROJECTS IN THE UNITED KINGDOM
Feb. 1966 46 p ref Presented at the 6th Intern. Symp. on Space Tech. and Sci., Tokyo, Nov.-Dec. 1965
(RAE-TR-66058) CFSTI: HC $2.00/MF $0.50

Throughout the last decade the United Kingdom has maintained an active programme of sounding rocket and ballistic missile development, from which the current space activities have emerged; the former weapon Blue Streak has become the first stage of the ELDO satellite launcher, Black Knight is being considered as the basis for a national launcher (Black Arrow), and Skylark is now used exclusively for space research. The paper describes these projects, as well as the U.K.3 and Black Arrow satellites, and concludes with a brief mention of related ground facilities. Author

N66-33203# Joint Publications Research Service, Washington, D. C.
NOTES ON THE SOVIET KOSMOS-110 FLIGHT
V. V. Parin 4 Aug. 1966 8 p Transl. into ENGLISH from Priroda (Moscow), no. 5, 1966 p 113-114
(JPRS-36853; TT-66-33283) CFSTI: $1.00

Briefly reported are the flight and landing of the Cosmos 110 satellite, and in-flight experiments on dogs. Weightlessness effects, and certain physiological and cardiovascular activity are outlined. Dosimetric measurements were made aboard to study radiation influences resulting from the spacecraft's trajectory through the earth's inner radiation belt. R.Li.

N66-33345*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PRELIMINARY INVESTIGATION OF INTERFERENCE EFFECTS OF MULTICOPLANAR FINS ON A TWO-STAGE ROCKET LAUNCH VEHICLE WITH WINGED SPACECRAFT AT TRANSONIC SPEEDS
P. Kenneth Pierpont Washington, NASA, Apr. 1962 28 p
(NASA-TM-X-677) CFSTI: HC $2.00/MF $0.50 CSCL 22D (Declassified)

A preliminary investigation has been made in 8-foot transonic pressure tunnel to determine the transonic aerodynamic characteristics of a two-stage fin-stabilized rocket launch vehicle in combination with a winged spacecraft. Effects of the winged spacecraft on the stability and axial-force contributions of the second-stage fins have been determined. The investigation was made for a range of test Mach numbers from 0.60 to 1.20 and a range of angles of attack from about $-2°$ to 10° at 0° sideslip. Reynolds number for the tests varied from 3.2×10^6 to 4.2×10^6 per foot. Installation of the first-stage fins reduced the variation of longitudinal stability parameter with Mach number to a negligible amount. The interference of the winged spacecraft decreased the magnitude of the stability contribution of the second-stage fins by about one-half and resulted in a negligible axial-force-coefficient penalty attributable to the second-stage fins. Author

N66-33397*# Consultants and Designers, Inc., Arlington, Va.
LUNA-10 COMPLETED ITS PROGRAM OF SCIENTIFIC INVESTIGATIONS
6 Jun. 1966 9 p Transl. into ENGLISH from Pravda (Moscow), no. 154 (17471), 3 Jun. 1966
(Contract NAS5-9299)
(NASA-CR-77010; ST-PR-10496) CFSTI: HC $1.00/MF $0.50 CSCL 22B

An official account of the accomplishments of Luna 10 is presented in two communiques, one by Tass and the other by the USSR Academy of Sciences. Various statistics for the moon-observing satellite are included, such as the facts that it completed 460 orbits around the moon and logged more than seven million kilometers. Nine gamma-radiation spectra of the lunar surface were obtained, as well as 10 magnetographic cutaways of the near-lunar space in the 352 to 1016 km range. M.W.R.

N66-33407*# Boeing Co., Seattle, Wash. Space Div.
THE LUNAR ORBITER
Apr. 1966 47 p Prepared for NASA Revised Supersedes X-66-13934
(NASA-CR-70499) CFSTI: HC $2.00/MF $0.50 CSCL 22B

The unmanned Lunar Orbiter mission, spacecraft design, ground equipment, and operations activity are described. Schematic diagrams of the photographic, electrical power, attitude control, velocity control, communications, and temperature control systems of the spacecraft are presented, along with a discussion of these systems. Discussion of the mission includes prelaunch, launch and boost, translunar flight, initial lunar orbit, and photographic mission phases, along with illustrative drawings. The various ground data handling facilities (AFETR, Deep Space Station, and Lunar Data Processing equipment) are also discussed along with block diagrams, a photograph, and drawings. Comparative resolution photos of the lunar landing site; a chart of the Lunar Orbiter Project organization; and photographs of the environmental testing facility, of the Atlas/Agena launch vehicle take-off, and of the Deep Space Station tracking antenna are given. L.S.

N66-33450*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

DYNAMIC-MODEL INVESTIGATION OF SOME LANDINGS AND SLIDEOUTS OF A RECOVERABLE BOOSTER

William C. Thompson Washington, NASA, Aug. 1966 23 p refs Film Supplement number L-901 to this report is available on Loan from NASA Langley Research Center, Langley Station Va.

(NASA-TN-D-3413) CFSTI: HC $1.00/MF $0.50 CSCL 22D

An investigation was made to study the landing and slideout stability characteristics during recovery of a reusable booster. The portion of the recovery operation considered herein deals with the initial landing impact and slideout stability on a hard-surface runway. Model tests were made at touchdown speeds simulating a full-scale horizontal velocity of 135 ft/sec (41 m/s) and a vertical velocity of 10 ft/sec (0.3 m/s). The four-skid landing system appeared to have very satisfactory stability. Several fixed nose-wheel arrangements were tested with the two-rear-skid configuration and all had a tendency to ground loop. Fairly good stability was obtained with a single free-castering nose wheel. The maximum longitudinal acceleration varied from 0.9 to 2.2 g units and the maximum normal acceleration varied from 1.6 to 4.6 units. The slideout distance varied from 8 to 11 booster lengths. Author

N66-33490*# General Dynamics/Fort Worth, Tex.

MANNED SPACECRAFT SYSTEMS COST MODEL, VOLUME II. Summary Report, Apr. 1965–Jun. 1966

D. E. Wagner 18 Jul. 1966 65 p

(Contract NAS9-3954)

(NASA-CR-65446; FZM-4671-2, Vol. II) CFSTI: HC $2.50/MF $0.75 CSCL 22B

A generalized structure and categories account, applicable to all types of spacecraft, was developed. A separate and independent model for evaluating up to eight contingencies was programmed. Cost estimates were developed in terms of nuclear power and propulsion, liquid propulsion, and advanced service module structures. Allowance was made for design changes, multiple learning curves, and inflation. Subroutines unique to spacecraft costing, such as one for reusability, are included. A growth potential makes reprogramming unnecessary if new data becomes available. A printout submodel and a submodel generating personnel and funding requirements for the flight center was developed. An improved method of generating funding or spreading costs over time, a multiple spacecraft costing capability, and a minimum input concept for a given problem run were additionally developed. The model has been validated and used in a series of actual costing exercises. K.W.

N66-33497*# General Dynamics/Fort Worth, Tex.

MANNED SPACECRAFT SYSTEMS COST MODEL, VOLUME I Condensed Summary Report, Apr. 1965–Jun. 1966

D. E. Wagner 18 Jul. 1966 28 p

(Contract NAS9-3954)

(NASA-CR-65445; FZM-4671-1, Vol. I) CFSTI: HC $2.00/MF $0.50 CSCL 22B

Results are summarized from a study undertaken to develop a mathematical model to develop improved cost estimates of advanced spacecraft. The model is capable of generating total costs attributable to NASA's Manned Spacecraft Center (MSC); it can be used to generate and to output costs in varying levels of detail, ranging from total program costs, to the cost of an individual spacecraft subsystem; and it can provide additional data which are required in the evaluation of MSC plans, resource requirements, and cost effectiveness measures. Technical details are not given in this summary, however recommendations for further study are delineated. H.S.W.

N66-33500*# National Aeronautics and Space Administration, Washington, D. C.

APOLLO SATURN HEAT SHIELD IN ORBIT TEST

21 Aug. 1966 37 p

(NASA News Release-66-213) Available from the Scientific and Technical Information Division CSCL 22D

A narrative account is given of the planned third unmanned Apollo/Uprated Saturn I flight. The major purpose of the flight is to perform the second performance check of the Apollo command module ablative heat shield. The shield will be subjected to extended high heat loads—approximately 23,000 BTUper square foot—resulting from a reentry path resembling a roller coaster ride on earth. The mission and flight sequence are outlined, the major Apollo spacecraft systems are discussed, and details are given on the Saturn I launch vehicle. H.S.W.

N66-33501*# General Dynamics/Fort Worth, Tex.

MANNED SPACECRAFT SYSTEMS COST MODEL, VOLUME III Technical Report, Apr. 1965–Jun. 1966

D. E. Wagner 18 Jul. 1966 139 p

(Contract NAS9-3954)

(NASA-CR-65447; FZM-4671-3, Vol. III) CFSTI: HC $3.00/MF $1.00 CSCL 22B

A technical report dealing with the development of a manned spacecraft systems cost model is presented. A comprehensive set of cost categories and corresponding model structure is established, which accounts for both recurring and nonrecurring costs and is sufficiently generalized to be applicable to all types of spacecraft. Cost estimating relationships are developed in terms of the following advanced technologies: nuclear power, nuclear propulsion, large liquid propulsion, and advanced service module structures. Special subroutines are provided for situations unique to spacecraft costing such as a reusability subroutine which takes into consideration turnaround time, number of spacecraft reuses, and probability of reuse. An improved method of generating funding or spreading costs over time is presented; and a multiple spacecraft costing capability for computing and displaying costs of up to 16 different spacecraft in a single problem run is discussed. A program description and model applications are included. S.P.

N66-33502*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

A NIKE FAILURE STUDY

Abrom Hisler Mar. 1966 28 p refs

(NASA-TM-X-55549; X-721-66-98) CFSTI: HC $2.00/MF $0.50 CSCL 16D

Sporadic Nike–Apache vehicle flight failures were viewed with concern prior to the first flight of the Nike boosted Aerobee 350 vehicle. The ensuing failure study, incorporating a functional sequence approach to reliability finally assessed the Nike malfunctions as induced by combustion instability and the "delta p" approach is advanced as a result. Nike assembly precautions were taken to avoid combustion instability failure modes as pinpointed by this "delta p" hypothesis. On June 18, 1965, the first attempt to launch the complete Aerobee 350 sounding rocket was a total success. Author

N66-33540*# National Aeronautics and Space Administration Wallops Station, Wallops Island, Va.
DEVELOPMENT OF A SMALL ANIMAL PAYLOAD AND INTEGRATION WITH A SOUNDING ROCKET
Larry J. Early, ed. Washington, NASA, 1966 110 p refs
(NASA-SP-109) CFSTI: HC $3.00/MF $0.75 CSCL 22B

A small-animal payload was designed, developed, and integrated with a modified Arcas launch vehicle to assist biological experimenters in evaluating the engineering and operational aspects of space flight research. This biospace launch vehicle is an unguided, single-stage, sounding rocket. Design criteria of the various payload systems and the resulting launch configuration are discussed, along with theoretical trajectory, vehicle aerodynamics, payload and recovery system design, biological bench testing, and payload flight qualification testing. Flight testing results of the complete biospace configuration are summarized. M.W.R.

N66-33555# TRW Systems, Redondo Beach, Calif.
BOOSTER ROCKET ALTITUDE ABORT PROGRAM Second Quarterly Progress Report, Period Ending 4 Jan. 1966
R. S. Ottinger and L. J. Van Nice Albuquerque, N. Mex., Sandia Corp., Jan. 1966 42 p refs Prepared for Sandia Corp.
(Contract AT(29-1)-789)
(SC-CR-66-2015) CFSTI: HC $2.00/MF $0.50

A theoretical model was developed to describe the launch-abort environment. Data from experimental work are used to establish major parameters and their quantitative relationships for application to the model to be used for fireball predictions. Author (NSA)

N66-33694*# National Aeronautics and Space Administration, Washington, D. C.
IN OPEN SPACE—VOSKHOD-2 SPACECRAFT DESIGN [V OTKRYTOM KOSMOSE—USTROYSTVO KORABLYA "VOSKHOD-2"]
D. Viktorov Jun. 1966 14 p Transl. into ENGLISH from Aviats. i Kosmonavt. (Moscow), v. 48, 1965 p 17–19
(NASA-TT-F-10216) CFSTI: HC $1.00/MF $0.50 CSCL 22B

Abridged versions of two official documents issued by the USSR Federation of Aviation Sports in connection with the orbital flight of the Soviet cosmonauts Belyayev and Leonov on Mar. 18, 1965 are presented. The documents are (1) a statement on the maximum distance of movements of Leonov outside the spacecraft, and (2) a report containing a comprehensive description of the design, instrumentation, and operation of the spacecraft (Voskhod-2). Author

N66-33718*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MARINER MARS 1964 PROJECT REPORT: MISSION AND SPACECRAFT DEVELOPMENT. VOLUME II: APPENDIXES
1 Mar. 1965 562 p
(Contract NAS7-100)
(NASA-CR-77110; JPL-TR-32-740) CFSTI: HC $6.12/MF $6.54 CSCL 22B

Basic working documents that were used during the project for monitoring and controlling the progress of spacecraft development are presented. Space flight operational procedures, mission objectives, system requirements, milestones, and an overall guideline schedule are provided. Desired process quality level specifications, drawing lists showing hardware design status, and the final design control freeze list are given. The total engineering change request listing, problems that were considered jeopardizing to the mission, and progress monitoring devices such as schedules, flow charts, trend graphs, delivery charts, and hardware system qualification matrixes are also included. A.G.O.

N66-33864*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
SATELLITE SITUATION REPORT, VOLUME 6, NO. 14
31 Jul. 1966 32 p
(NASA-TM-X-57833) CFSTI: HC $2.00/MF $0.50 CSCL 22C

A tabulation of objects in earth orbit covering the period from 1958 through 31 July, 1966 is presented. Included for each satellite are the country source, launch data, period, inclination, apogee, perigee, and in some cases the transmitting frequency. C.T.C.

N66-34035# Royal Aircraft Establishment, Farnborough (England).
TABLE OF SPACE VEHICLES LAUNCHED IN 1958–65
H. Hiller Mar. 1966 17 p refs
(RAE-TR-66103) CFSTI: HC $1.00/MF $0.50

All known space vehicles launched before 1 January 1966, which are not close Earth satellites are tabulated here. The Table is divided into two sections, under the headings (A) heliocentric orbits and (B) geocentric and selenocentric orbits. Section A is a list of space vehicles which finally orbit round the Sun, while Section B is for space vehicles which remain within the dominance of the gravitational attraction of the Earth–Moon system. Author

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N66-32725*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LARGE DEFLECTION AND STABILITY ANALYSIS BY THE DIRECT STIFFNESS METHOD
Harold C. Martin 1 Aug. 1966 42 p refs
(Contract NAS7-100)
(NASA-CR-76892; JPL-TR-32-931) CFSTI: HC $2.00/MF $0.50 CSCL 20K

The application of the direct stiffness method in the solution of large deflection and stability problems is demonstrated. Discussed first are the basic elasticity equations that contain higher order terms to account for the nonlinear character of large deflections and rotations. Various simplifications of these equations are made, and the conditions and limitations of the resulting expressions are discussed. Next, examples of geometrically nonlinear systems are presented to illustrate the

importance of considering the nonlinear behavior in many problems. Finally, the modifications to the stiffness matrix, and the method of formal solution are derived for some of the nonlinear examples that have been discussed. Author

N66-32788*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.

DYNAMIC STABILITY OF A UNIFORM FREE-FREE BEAM UNDER A GIMBALED THRUST OF PERIODICALLY VARYING MAGNITUDE

Thomas Reynolds Beale Jun. 1963 87 p refs
(Grant NsG-133-61)
(NASA-CR-76925; SUDAER-161) CFSTI: HC $2.50/MF $0.75 CSCL 20M

The thesis considers the dynamic stability of the bending vibrations of a uniform free-free beam subjected to an end thrust of magnitude $T_0+T_1 \cos \Omega t$, where T_0 and T_1 are constants. The mathematical model considered approximates an actual rocket vehicle. The direction of the thrust is assumed to be controlled by means of a simple feedback system which uses an attitude sensor to control the thrust gimbal angle; thus the beam would have directional stability as a rigid body. The equations of motion are derived for two-dimensional motion. Longitudinal compliance of the beam is included, but shear deformations, damping, and rotary-inertia effects are neglected. Small distortions are assumed. When the thrust is assumed to be constant ($T_1=0$), the magnitude of the critical thrust considerably exceeds the actual thrust of current, large missiles. On the other hand, the existence of parametric instabilities due to periodic variations in the thrust magnitude is a definite possibility in modern missiles. Furthermore, it appears that longitudinal compliance may play a significant role in these instabilities. Author

N66-32878# Sandia Corp., Albuquerque, N. Mex.

A STUDY OF IMPACT EFFECTS ON SPHERICAL SHELLS

Quarterly Progress Report No. 9, 1 Nov. 1965–31 Jan. 1966
Charles E. Stoneking [1966] 30 p refs
(Contract AT(29-1)-789)
(SC-CR-66-2025) CFSTI: HC $2.00/MF $0.50

A study was made to investigate the structural integrity of hollow spheres when they are impacted against a rigid target of known properties. Physical characteristics of the test items to be varied are: (1) diameter, (2) thickness, (3) filler material, and (4) material of construction. The magnitude of the effects of impact are studied by measuring: (1) rupture velocity of impact, (2) impact pressure, (3) rebound velocity, (4) contact time, and (5) other quantities as circumstances dictate. With the results of the tests, a least squares method is used to establish an empirical equation relating rupture velocity and the variable parameters. During the present report period considerable progress was made on the theoretical analysis of both hollow cylinders and hollow spheres subjected to impact loads. A comparison of the impact effects on a short cylinder with a hemispherical end and a hollow sphere was made. NSA

N66-33024*# Midwest Research Inst., Kansas City, Mo.

FLUTTER OF MULTIPLE-STREAMWISE BAY RECTANGULAR PANELS AT LOW SUPERSONIC MACH NUMBER

D. R. Kobett Washington, NASA, Aug. 1966 35 p refs
(Contract NAS1-4900)
(NASA-CF-538) CFSTI: HC $2.00/MF $0.50 CSCL 20K

A flutter analysis is conducted of simply supported flat panel arrays made up of one spanwise bay and one, two and three streamwise bays. The arrays are of finite span in contrast with previous analyses which treat either the two-dimensional case or the case of infinite span divided into equal bays. Use is made of linear plate theory and complete, linearized, three-dimensional, inviscid aerodynamic theory. The effects of structural damping and aerodynamic and structural coupling are included. Solutions to the flutter equations are obtained using the Galerkin technique. The flutter mode shapes of the multiple bay arrays are dominated by structurally uncoupled modes. It is concluded that aerodynamic coupling is the primary mechanism of destabilization. Author

N66-33025*# Pittsburgh Univ., Pa.

THE EIGENVALUE PROBLEM FOR BEAMS AND RECTANGULAR PLATES WITH LINEARLY VARYING IN-PLANE AND AXIAL LOAD

Guy Fauconneau and William M. Laird Washington, NASA, Aug. 1966 36 p refs
(Grant NsG-634)
(NASA-CR-549) CFSTI: HC $2.00/MF $0.50 CSCL 20K

The equation of motion and boundary conditions for uniform beams carrying constant end thrust and linearly varying axial load are derived from Hamilton's principle. Previous studies on the determination of natural frequencies of beams with varying axial loads are reviewed. The eigenvalue problem is formulated in a variational form to facilitate approximate solutions. The equation of motion of uniform plates carrying in-plane loads is derived from Hamilton's principle. The eigenvalue problem for a rectangular plate carrying a linearly varying in-plane load parallel to one side is transformed into that of a uniform beam subjected to a uniformly distributed axial load whenever the sides of the plate parallel to the loading are simply supported. The eigenvalues for the beam are presently being computed and will be tabulated. Author

N66-33076*# National Aeronautics and Space Administration, Washington, D. C.

STRUCTURAL SYSTEMS AND PROGRAM DECISIONS, VOLUME 2

[1966] 276 p
(NASA-SP-6008) CFSTI: HC $3.75/MF $1.50 CSCL 22B

A detailed description of the programming of the structural weight optimization computer program is presented. Details of mathematical techniques such as iterations used in the procedures for optimizing each construction, and instructions for corrective measures are also provided. The stress and the construction subprograms are covered, and the subroutines developed for the single-face corrugation, semi-monocoque and the integral ring and stringer stiffened construction subprograms are described. Additionally flow charts which can be used for planning purposes to provide expansions and additions to the program are included. H.S.W.

N66-33082# Joint Publications Research Service, Washington, D. C.

THE PROPAGATION OF WAVES IN A BOUNDED ELASTIC-PLASTIC ROD IN A CASE OF LONGITUDINAL IMPACT

G. G. Konstantinov, L. L. Marchenko, and K. N. Shkhinek *In its* Studies in Phys. of Combust. and Explosion (No. 4, 1965) 25 Jul. 1966 p 35-44 ref (See N66-33077 19-33) CFSTI: $3.00

The problem of the propagation of disturbance waves in a bounded (limited) elastic-plastic rod with one free end is considered, in which the other end adjoins an elastic semi-infinite rod. The problem is solved for a specific form of load on the free end and a particular equation of state of the material of the rod—a stress-strain diagram. Calculation dependences were obtained for determining the maximum possible residual displacements of the section of an elastic-plastic rod under consideration with relationship to the interface of the rods. Dependences were obtained establishing the

possibility of the origin of cavitation of the material of the rod and the place where it sets in. Author

N66-33083# Joint Publications Research Service, Washington, D. C.

EXPERIMENTAL STUDY OF EXPLOSION STRESSES IN SOFT GROUND ON ENGINEERING STRUCTURES

L. I. Koshelev, N. N. Popov, and P. I. Yartsev *In its* Studies in Phys. of Combust. and Explosion (No. 4, 1965) 25 Jul. 1966 p 45–53 (See N66-33077 19-33) CFSTI: $3.00

The effects of the parameters of the underground explosion and the dynamic properties of the structure on the magnitude of the equivalent stress were investigated. Parameters considered during preliminary tests on models were weight of charge, distance and depth of charge, wave impact angle on obstacle, natural oscillation frequencies of the obstacle, and soil properties. The TNT charges in the model tests varied in amount, with 1 kg being the maximum. The ground was either natural sand, sand saturated with water, or natural clay. The obstacles were horizontally or vertically placed H beams having a span of 1.0 or 1.5 m. Mechanical and magnetoelectric measurements to determine the bendings were made in the middle and at a quarter of the spans. From the measurements were calculated the static stresses and the heterogeneity of the stress distribution. Model tests were followed by tests with charges up to 225 kg on larger structures. Theoretical calculations were also made for charges from 500 to 5000 kg. Experimental results were found to be in agreement with theoretical calculations. K.W.

N66-33139# Forest Products Lab., Madison, Wis.

BUCKLING OF SIMPLY SUPPORTED PLYWOOD PLATES UNDER COMBINED EDGEWISE BENDING AND COMPRESSION

John J. Zahn and Karl M. Romstad Dec. 1965 24 p refs (PB-169102)

The problem of a flat, rectangular plywood plate with all edges simply supported and with edge load in the plane of the plate on two opposite edges is considered. The intensity of this compressive edge force varies linearly along the loaded edges; hence, the result of this distribution is a compressive edgewise force P at the center of a loaded edge and an edgewise bending moment M. The relative magnitude of P and M are specified by parameter which varies from $0<\alpha<2$, the extreme values corresponding to pure compression and pure bending, respectively. The natural orthotropic axes of the plies were taken to be parallel to the coordinate axes. The energy method of solution was used. A double sine series was used to represent the deflected surface of the buckled plate and four terms were retained in the computations, although nearly always three would have been sufficient for less than 1 percent error. Curves were computed with the aid of an IBM 1620 computer and are presented as a family of curves of a nondimensional buckling coefficient versus a reduced aspect ratio. The family is dependent upon two parameters, α and C, the latter containing the elastic properties of the plies. Author

N66-33172*# National Aeronautics and Space Administration, Washington, D. C.

STRUCTURAL APPLICATIONS FOR ADVANCED COMPOSITE MATERIALS

Norman J. Mayer [1964] 18 p refs

(NASA-TM-X-54880) CFSTI: HC $1.00/MF $0.50 CSCL 20K

Structural requirements for space vehicles place emphasis on the use of light-weight, high-strength materials. The combination of two or more different materials into composites has produced superior characteristics over single phase arrangements. The greatest advantage will result from the provision of a method for predicting the properties of composites based on the properties of their constituents. When this is accomplished, composites can be developed to render optimum performance for their specific applications. A 9-step program is envisioned to meet the goal of prediction and optimization. It would involve both analytical and experimental development. Several steps must be taken simultaneously in order to provide feedback and demonstrate potential for various forms and types of materials. Author

N66-33297# Army Engineer Waterways Experiment Station, Vicksburg, Miss.

THE ELASTIC RESPONSE OF BURIED CYLINDERS. CRITICAL LITERATURE REVIEW AND PILOT STUDY Final Technical Report, Jan. 1964–Jul. 1965

Gayle E. Albritton, Jesse L. Kirkland, Thomas E. Kennedy, and Albert F. Dorris Apr. 1966 104 p refs

(TR-1-700; AD-633673) Available from Army Engr. Waterways Expt. Station, Vicksburg, Miss: HC $1.00; CFSTI: MF $0.75

Three series of tests were conducted on the cylinder under both static and dynamic loading conditions in the small (4-foot-diameter) blast load generator. The cylinder had a test section length of 12 inches, a diameter of 6 inches, a stiffness EI/R cubed of 164, and a diameter-to-thickness ratio D/T of 50. The surface overpressures ranged from 0 to 350 psi static and from 100 to 250 psi dynamic. The depth of cover over the crown ranged from 0 to 12 inches of soil. Measurements were made of strain in the cylindrical section, surface overpressure, and the associated free-field pressure. The dynamic strains were 20 to 40 percent higher than the strains at an equivalent static load. Load cycling had negligible effect on the elastic response of the cylinder. Thrust was generally a linear function of the applied surface overpressure; however, moment was highly nonlinear and tended to increase at a decreasing rate. The state of the art concerning dynamic, elastic theory for rings was summarized, including an analysis of the mathematical and physical limitations of the currently available theories. Author (TAB)

N66-33350*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

FLUTTER INVESTIGATION AT A MACH NUMBER OF 7.2 OF MODELS OF THE HORIZONTAL-TAIL AND VERTICAL-TAIL SURFACES OF THE X-15 AIRPLANE

Frederick W. Gibson and Johns S. Mixson Washington, NASA, May 1959 29 p refs

(NASA-MEMO-4-14-59L) CFSTI: HC $2.00/MF $0.50 CSCL 20K (Declassified)

The dynamic pressure at flutter of the horizontal- and vertical-tail models corresponded to full-scale values of 13,500 pounds per square foot and 8,900 pounds per square foot, respectively. Since the full-scale airplane is not expected to be subjected to a dynamic pressure in excess of 2,500 pounds per square foot, a large factor of safety appears to be indicated. However, only the total stiffnesses of the full-scale tail surfaces as individual cantilevers were simulated. The effects of local stiffnesses and possible reactions between the horizontal- and vertical-tail surfaces and between the body motions and the tail surfaces were not considered. Author

N66-33351*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

NACA CONFERENCE ON AIRCRAFT LOADS, FLUTTER, AND STRUCTURES: A COMPILATION OF THE PAPERS PRESENTED

[1955] 586 p refs Conf. held at Langley Field, Va., 2-4 Mar. 1955
(NASA-TM-X-57821) CFSTI: HC $6.36/MF $3.00 CSCL 20K (Declassified)

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1. CRITICAL LOADING CONDITIONS Charles H. Zimmerman et al 34 p refs
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8. WING FLUTTER Laurence K. Loftin, Jr. et al 47 p refs
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10. INTRODUCTORY REMARKS ON THE STRUCTURAL EFFECTS OF AERODYNAMIC HEATING John E. Duberg 9 p
11. AERODYNAMIC HEATING A. J. Eggers, Jr. et al 23 p refs
12. STRUCTURES AT ELEVATED TEMPERATURES George J. Heimerl et al 52 p refs
13. STRESSES AND DEFLECTION John M. Hedgepeth et al 31 p refs
14. STRENGTH James P. Peterson et al 15 p refs
15. FATIGUE FAILURE Walter Illg et al 15 p refs

N66-33352*# National Aeronautics and Space Administration, Washington, D. C.
THERMAL PROTECTION SYSTEMS. ASPECTS OF THERMAL PROTECTION OF INTEREST TO NASA AND THE RELATED MATERIALS R AND D REQUIREMENTS
Feb. 1962 216 p refs
(NASA-TM-X-650) CFSTI: HC $3.75/MF $1.25 CSCL 22B (Declassified)

The investigations of various proposed methods for heat alleviation of aerospace and power plant structures are summarized. The present state-of-the-art of thermal protection is reviewed, and the problem areas are defined. It was concluded that a wide variety of thermal protection systems must be developed. The principles of thermal protection are well established, but it is pointed out that engineering properties and parameters are not available, and standardized test methods for materials and related test devices are nonexistent. It was further concluded that considerable more information and knowledge is needed before optimum thermal protection systems can be reliably designed for the more critical applications.
N.E.N.

N66-33369*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECT OF TARGET MATERIAL YIELD STRENGTH ON HYPERVELOCITY PERFORATION AND BALLISTIC LIMIT
Robert G. Thomson and E. T. Kruszewski [1964] 48 p refs Presented at the 7th Hypervelocity Impact Symp., Tampa, Fla., 17-19 Nov. 1964
(NASA-TM-X-54874) CFSTI: HC $2.00/MF $0.50 CSCL 20K

A visco-plastic flow theory for the solution of hypervelocity perforation of thin plates has been investigated. A short time analytical solution including the effects of target material yield strength on perforation radii and ballistic limits was obtained. Expressions were derived for the velocities, displacements, strains, and strain rates present in the target material during hypervelocity impact. Pertinent parameters were varied and a comparison was made with the solution in which the yield strength was taken to be zero. The effect of target material yield strength was not found to be significant and resulted in little variation in the computed perforation radii. Ballistic limit studies were also performed in which minimum plate thicknesses necessary to prevent perforation were established for projectiles of various masses, radii, and impacting velocities. Yield strength considerations were found to be of secondary importance; the more critical effect being produced by the projectile aspect ratio at impact. Author

N66-33375*# Alabama Univ., University. Bureau of Engineering Research.
ON CONICAL SHELLS OF LINEARLY VARYING THICKNESS SUBJECTED TO LATERAL NORMAL LOADS Progress Report No. 1
Chin Hao Chang Feb. 1965 33 p refs
(Contract NAS8-11155)
(NASA-CR-62481) CFSTI: HC $2.00/MF $0.50 CSCL 20K

The basic equations of conical shells of linearly varying thickness and an approach to the homogeneous solutions were given in "Stresses in Shells" by W. Flügge. The homogeneous solutions were hinged on an eighth degree characteristic equation. In this report, along the line of the theory, the characteristic equation is given in a different form, and a method of solving the equation is also presented. When let the ratio of the end thickness to total length approach zero asymptotically, it is found that the solution consists of two parts: membrance and bending. The two parts are coupled by the lateral displacement. The particular solutions due to lateral normal loads are also given along with a numerical example of a truncated semi-circular cone. Author

N66-33381*# Georgia Inst. of Tech., Atlanta.
DYNAMIC RESPONSE OF A CYLINDRICAL SHELL SEGMENT SUBJECTED TO AN ARBITRARY LOADING
Wolfram Stadler and James T. S. Wang [1965] 29 p refs Presented at 9th Midwestern Mech. Conf., Madison, Wisc., 16-18 Aug. 1965 Submitted for Publication
(Grant NsG-S71)
(NASA-CR-67184) CFSTI: HC $2.00/MF $0.50 CSCL 20K

Closed form expressions are obtained for the displacement, in the radial, circumferential and axial directions respectively, for a cylindrical shell segment subtended by an arbitrary angle θ_0 and subjected to an arbitrary load-distribution. Laplace and finite fourier since and cosine transforms are employed to accomplish the solution. A numerical example, utilizing an idealized equivalent triangular blast load, is included to provide a comparison with available experimental data as found in the literature. Furthermore, the effect of the magnitude of the thickness to radius of curvature ratio ($\frac{h}{R}$), and of the negligence of the inertial terms in the axial and circumferential directions, on the frequencies, are investigated.
Author

N66-33400*# Wichita Univ., Kans. Dept. of Aeronautical Engineering.
SOME FREE VIBRATION AND DYNAMIC RESPONSE PROBLEMS ASSOCIATED WITH CENTRIFUGALLY STABILIZED DISK AND SHELL STRUCTURES Semiannual Progress Report, 15 Feb.-15 Aug. 1966

Walter Eversman Aug. 1966 14 p refs
(Contract NGR-17-003-004)
(NASA-CR-77014) CFSTI: HC $1.00/MF $0.50 CSCL 20K

Natural frequencies and normal vibration modes have been determined for the free vibrations of flat spinning annular membrane disks, and the analysis has been extended to shallow membrane shells of revolution, which are centrifugally stabilized. Hub configurations studied are either (1) completely clamped, with both radial and transverse displacements of the disks constrained, or (2) loosely clamped, with only transverse displacements displaced. Major emphasis has been on the formulation of equations of motion and solution techniques for the flat spinning annular elastic membrane completely clamped by a rigid hub, with the axisymmetric case for this hub being extended to cases when there are no nodal diameters. The governing differential equation for the radial dependence of the mode shape is given, and solutions are obtained by introducing the origin shift for expansion in a power series about the singular point at the disk free edge. The problem is then reduced to one of finding coefficients, by using recurrence relations, of the assumed series solution so that the deflection vanishes at the hub radius. M.W.R.

N66-33456*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
VIBRATIONAL CHARACTERISTICS OF SANDWICH PANELS IN A REDUCED-PRESSURE ENVIRONMENT
Clemans A. Powell, Jr. and David G. Stephens Washington, NASA, Aug. 1966 19 p refs
(NASA-TN-D-3549) CFSTI: HC $1.00/MF $0.50 CSCL 20K

An investigation was conducted to determine the vibrational characteristics of sandwich panels over a wide range of environmental pressure or density. Natural frequencies and damping of panels have aluminum honeycomb and polyurethane foam cores were determined for several modes of vibration over a pressure range from 760 (1 atmosphere) to 10^6 torr. Results indicate that no significant changes in either natural frequency or damping occur between a pressure of 1 and 10^{-6} torr. A decrease in pressure from 1 atmosphere to 1 torr produces an increase in frequency from 2 to 10 percent due to apparent mass effects and possible increases in panel thickness and shear rigidity. Furthermore, a corresponding decrease in pressure results in a linear decrease in damping due to a reduction in acoustic radiation. The change in frequency and damping with pressure is dependent upon the mode shape of the panel. Author

N66-33460*# Stanford Univ., Calif.
AN EXPERIMENTAL STUDY OF THE BUCKLING OF COMPLETE SPHERICAL SHELLS
R. L. Carlson, R. L. Sendelbeck, and N. J. Hoff Washington, NASA, Aug. 1966 65 p refs
(Grant NsG-630)
(NASA-CR-550) CFSTI: HC $3.00/MF $0.75 CSCL 20K

Complete spherical shells with radius to thickness ratios of from 1570 to 2120 were produced by the electroforming process. For specimens of good quality and for optimum testing conditions, buckling pressures up to 86 percent of the classical buckling pressure were obtained. The effect of loading system characteristics was examined by pressurizing spherical shells in both rigid and soft systems. Contrary to expectations based on the Tsien hypothesis, each shell buckled at the same pressure in both systems. This indicates that the Tsien hypothesis cannot be used as an explanation for the occurrence of low buckling pressures. The test results obtained suggest that test performance is related to the nature and severity of flaws or imperfections i.e., low buckling pressures can be correlated with the presence of severe flaws or nonuniformities. Author

N66-33465*# California Inst. of Tech., Pasadena.
THE INFLUENCE OF THE BOUNDARY CONDITIONS ON THE BUCKLING LOAD OF CYLINDRICAL SHELLS UNDER AXIAL COMPRESSION
Shigeo Kobayashi Washington, NASA, Aug. 1966 29 p refs
(Grant NsG-18-59)
(NASA-CR-558) CFSTI: HC $2.00/MF $0.50 CSCL 20K

A new approach was made to the study of the effect of boundary conditions on thin walled axial cylinders loaded with uniform axial compression, which leads to a graphical representation that establishes limits on the buckling stress without detailed calculation. The effect of elastic boundary conditions is also studied. Author

N66-33467# Brown Univ., Providence, R. I. Div. of Applied Mathematics.
THE EXISTENCE OF ONE-DIMENSIONAL STEADY SHOCK WAVES IN NONLINEAR MATERIALS WITH MEMORY
James M. Greenberg Apr. 1966 51 p refs
(Contract Nonr-562(40))
(TR-8; AD-634533) CFSTI: HC $2.00/MF $0.50

The dissertation establishes that for a large class of nonlinear materials with memory it is possible to find one dimensional steady motions which satisfy balance of momentum and exhibit stationary shock waves. Author (TAB)

N66-33473# Lehigh Univ., Bethlehem, Pa. Dept. of Applied Mechanics.
ON THE WESTERGAARD METHOD OF CRACK ANALYSIS
G. C. Sih Mar. 1966 11 p refs
(Contract Nonr-610(06))
(TR-1; AD-634356) CFSTI: HC $1.00/MF $0.50

The Westergaard method of crack analysis, published almost thirty years ago, is shown to be invalid for a class of crack problems dealing with the infinite medium with cracks under applied loads at infinity. The necessary modifications of the Westergaard method are derived from the complex potential formulation of Muskhelishvili. The examples of a single line crack in an infinite plate owing to biaxial tension and pure shear are discussed. Author (TAB)

N66-33516# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.
BUCKLING OF RADIALLY CONSTRAINED THIN CIRCULAR RINGS UNDER INERTIA LOADING
T. H. H. Pian Feb. 1966 19 p ref
(Grants AF-AFOSR-347-64; AF-AFOSR-347-65)
(ASRL-TR-136-1; AFOSR-66-0502; AD-634433) CFSTI: HC $1.00/MF $0.50

This paper presents an approximate solution of the elastic deformation of a thin circular ring which is constrained in a rigid circular boundary and is acted upon by inertia loading along direction in the plane of the ring. The solution is based on the assumption that the detached region is limited to a small portion of the circumference. The result of the solution is represented by a load-deflection-curve which indicates the snap-buckling behavior of the ring. By presenting the results in terms of suitable nondimensional parameters, the behavior of rings of different R/t ratios can be determined from a single curve. The approximate solution compares favorably with the result by exact formulation obtained by Bucciarelli and Pian (AD-623 150) for a thin ring of R/t equal to 100. The predicted snap-buckling load is lower by about 3% when compared with the exact result. Author (TAB)

N66-33525# Lehigh Univ., Bethlehem, Pa. Dept. of Applied Mechanics.
THREE-DIMENSIONAL THERMOELASTIC PROBLEMS OF PLANES OF DISCONTINUITIES ON CRACKS IN SOLIDS

Mumtaz K. Kassir and George C. Sih Apr. 1966 45 p refs
(Contract Nonr-610(06))
(TR-2; AD-634357) CFSTI: HC $2.00/MF $0.50

A general formulation of the three-dimensional thermoelastic equations for problems involving planes of discontinuities is presented. Harmonic functions are constructed from which the stresses and displacements may be obtained. The thermoplastic potential for symmetric distribution of temperatures on the crack surfaces is related to Boussinesq's three-dimensional logarithmic potential for a disk in the shape of the crack. Closed form solutions are obtained for the cases of crack surfaces exposed to uniform temperatures and/or temperature gradients. The possibility of extending the Griffith–Irwin theory of fracture to cracks under thermal disturbance is also discussed. Author (TAB)

N66-33572* De Havilland Aircraft Co., Ltd., Malton (Onatrio). Special Products and Applied Research Div.
TEST PROGRAM ON THIN-WALLED TUBES WITH ZERO THERMAL GRADIENT Final Report
Howard S. Kerr, J. Flood, and R. Spencer Jun. 1966 198 p refs
(Contract NAS5-9572)
(NASA-CR-76917; DHC-SP-R.168-Z) CFSTI: HC $3.75/MF $1.25 CSCL 20K

This report outlines the method and results of a test program on the deflection characteristics of thin walled stem tubes that have been perforated with a random spiral hole pattern to produce equal absorption of radiant power on the front and rear surface of the stem, thereby reducing thermal bending due to temperature gradient. A thermal source-vacuum chamber capable of testing the bending characteristics of 16 foot perforated stem samples under high vacuum conditions was constructed. Studies were made on perforation patterns, the reflectivity and absorptance characteristics of the coatings used, the straightness and diameter characteristics of perforated stem tubes, perforated stem strength measurements compared to unperforated samples, and film thickness measurements of the silver coatings used. The test program demonstrated the feasibility of producing "zero bending" stems for the chamber environment. It also demonstrated that reproducible high reflectance (low solar absorptance) silver films can be produced by electrodeposition. Results indicated that for the 1100° C thermal source in the vacuum chamber an area removal of 5% results in a "zero bending" stem. Under the same conditions at 12% area removed stem would be "zero bending" under solar radiation in space. Strength tests showed that a 20% area removal reduced its strength to half that of an unperforated stem. Author

N66-33593# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ANTISYMMETRICAL STRESSED STATE OF A CONICAL SHELL OF VARIABLE THICKNESS
Ya. M. Grigorenko 21 Jan. 1966 15 p refs Transl. into ENGLISH from Prik Mekh. (Kiev), v. 6, no. 4, 1960 p 385–392
(FTD-TT-65-1377/1+2+4; AD-633818) CFSTI: HC $1.00/MF $0.50

The author considers the antisymmetrical stressed state of a conical shell of variable thickness. A system of basic differential equations of the fourth order is dervied. An approximate equation in complex form is also obtained, and its solution is given in the form of hypergeometric functions. Author (TAB)

N66-33595# Louvain Univ. (Belgium). Dept. of Applied Mechanics.
DYNAMIC BEHAVIOR OF SHELLS UNDER THERMAL STRESS Scientific Report
Felix Buckens 1965 124 p refs
(Grant AF-EOAR-63-49)
(AFOSR-66-0898; AD-634109) CFSTI: HC $4.00/MF $0.75

The effect of initial stress and in particular of thermal stress on the dynamical behavior of thin shells (vibration and propagation of bending waves) is studied. The case of a circular cylindrical is considered in detail, and several effects of initial stress and distributed moment evaluated. Methods of determining initial thermal stress and deflection are given and their effects on natural frequencies and modes considered. Local effects on the velocity of propagation of bending waves are studied in detail and quantitative evaluations are obtained. Comparison with experimental results is given. Author (TAB)

N66-33598# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FATIGUE DURING ELASTIC-PLASTIC DEFORMATION
R. M. Shneyderovich 21 Jan. 1966 28 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk. Mekhan. i Mashinostr. (Moscow), 1964 p 194–210
(FTD-TT-65-1413/1+2; AD-633658) CFSTI: HC $1.00/MF $0.50

The destructive deformations in steel structures, and the flow of the cyclic destruction are reviewed. Destructive deformations with flexible and inflexible loads are described. The dependence of destruction during elastic-plastic cyclic deformation on frequency, and nonhomogeneity of loaded states are discussed. A table of parameters of cyclic deformation for various steels is presented. It is shown that the change of nonhomogeneous tensile state depends on the cyclic deformation. N.E.N.

N66-33599# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FUNDAMENTAL PLANE STATIC PROBLEMS OF THEORY OF ELASTICITY FOR SIMPLY CONNECTED AND DOUBLY CONNECTED REGIONS
S. M. Belonosov 9 Mar. 1966 244 p refs Transl. into ENGLISH of the book "Osnovnyye Ploskiye Staticheskiye Zadachi Teorii Uprugosti Dlya Odnosvyaznykh i Dvusvyaznykh Oblastey" Novosibirsk, Izd. Sibirskogo Otd. an SSR, 1962 p 1–231
(FTD-MT-64-389; AD-633819) CFSTI: HC $6.00/MF $1.25

In the book there is expounded a new general method of solution of plane static problems of theory of elasticity. Main attention is paid to investigation of influence of angular points of region. There are given recommendations relative to numerical solution of plane problems with use of electronic computers. The book is intended for scientists studying theory of elasticity and boundary value problems of mathematical physics connected with application of integral equations and methods of theory of functions of a complex variable. Author (TAB)

N66-33615# Princeton Univ., N. J. Dept. of Civil Engineering.
THE DETERMINATION OF SOIL PROPERTIES IN SITU BY AN IMPACT PENETROMETER Scientific Report No. 1
Werner E. Schmid Jan. 1966 192 p refs *Its* Soil Eng. Res. Ser. No. 3
(Contract AF 19(628)-2427)
(AFCRL-66-43; AD-634043) CFSTI: HC $5.00/MF $1.00

This report presents parts of the scientific investigations carried out under a task program related to the determination and assessment of surface dynamic soil properties by laboratory instrumentation. It first reviews the historical development of the hardness-penetrometer concept and presents a pilot model for a new aerial penetrometer. Basic theoretical considerations are then advanced regarding the stress–strain relationships in axial symmetry and the dynamic loads associated with a drop-impact penetrometer. The existing theory

of elasticity solutions are then reviewed and the solutions for a sphere impacting on an ideally plastic and on an elasto-plastic semi-infinite solid are presented. The Hertz solution of an elastic sphere impacting on an elastic half-space is modified by using the elastic–viscoelastic analogy to find a solution for a sphere dropping onto a four parameter viscoelastic half-space. The problem of energy transfer during impact by vibrations is discussed shortly. The data for fifteen test series carried out with the pilot model penetrometer on natural soils and on some artificial materials are presented and evaluated. It is concluded that the principle of the drop impact-penetrometer is applicable in experiments for assessing the mechanical properties of a natural soil surface. Author (TAB)

N66-33645# Houston Univ., Tex. Dept. of Mechanical Engineering.

THE IN-VACUO VIBRATIONS OF A SIMPLY SUPPORTED, RING-STIFFENED, MASS-LOADED CYLINDRICAL SHELL

Constantine D. Michalopoulos and Douglas F. Muster Jun. 1966 35 p refs

(Contract Nonr-4492(01))

(TR-3; AD-633676) CFSTI: HC $2.00/MF $0.50

The present investigation is an analytical study of the in-vacuo free vibrations of a simply supported, mass-loaded thin cylindrical shell which is reinforced by equally spaced ring stiffeners. Four masses are attached to each stiffening ring in a plane-symmetric fashion. The rotatory inertia of the mass loads is taken into account, but similar effects for the shell and ring stiffeners are neglected. Lagrange's equations are used to derive the dynamic equations of the structure. Results are given for various combinations of length, radius and thickness of the shell, number of stiffening rings, and value and position of mass loads. When the value of the masses is allowed to become zero, the results for the ring-stiffened shell are in close agreement with those of previous investigators. Author (TAB)

N66-33658# California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.

THE EFFECT OF COUPLE-STRESSES ON THE STRESS CONCENTRATION AROUND A CRACK

Eli Sternberg and Rokuro Muki Apr. 1966 48 p refs

(Contract Nonr-220(58))

(TR-6; AD-634186) CFSTI: HC $2.00/MF $0.50

A solution is obtained, within the linearized couples-stress theory of elastic behavior, to the problem presented by a crack of finite length in a uniform field of transverse tension. The results, which are based on the assumption of plane strain, are discussed in detail and compared with their counter-part in classical elastostatics. Author (TAB)

N66-33665# Naval Ordnance Lab., White Oak, Md. Underwater Explosions Div.

THE RESISTANCE OF HOLLOW GLASS MODELS TO UNDERWATER EXPLOSIONS AT GREAT DEPTHS. III: SPHERES WITH OVERLAYS

Thomas B. Heathcote 17 May 1966 21 p refs

(NOLTR-66-78; AD-634111) CFSTI: HC $1.00/MF $0.50

Hollow glass spheres, 10 inches in diameter, were exposed to implosions of nearby spheres at 7,000, 10,000, and 21,000 ft depths in the ocean. Coatings of butyl and neoprene rubber, and syntactic foam increased the damage resistance at depth slightly; no significant differences among the three coatings nor between 1/2-inch and 1-inch thicknesses were found. Limited data indicate that resistance to implosions increases with depth. Author (TAB)

N66-33763# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.

THERMAL PROTECTION SYSTEMS. APPLICATION RESEARCH OF MATERIALS PROPERTIES AND STRUCTURAL CONCEPTS

Wright-Patterson AFB, Ohio. AF Mater. Lab., Jan. 1965 675 p refs

(Contract AF 33(606)-7483)

(RAD-TR-62-14; AFML-TDR-64-82; AD-611772) CFSTI: HC $9.80/MF $3.00

Pertinent factors affecting the function of thermal protection systems are reviewed with emphasis on glide re-entry applications. Review is made and new information is generated in the areas of: (1) system, material, and design performance criteria needed for evaluation, (2) methods and techniques necessary for experimental and theoretical acquisition of the necessary parameters, (3) correlation of data to present information of the material selection and development effort, and protection system design use, (4) design and development techniques for built-up shield structure components (vehicle sizing), and (5) basic mechanisms of heat and mass transfer associated with the mode of heat abosrption or dissipation and of load carrying and transmission capacity. TAB

N66-33778# Pennsylvania State Univ., University Park. Ordnance Research Lab.

INTERNAL FRICTION STUDIES ON BELL METAL AND WOOD

R. Kerlin 14 Mar. 1966 55 p refs

(Contract NOw-65-0123-d; Grant AF-AFOSR-43-63)

(TM-603.2811-05; AD-630798) CFSTI: HC $3.00/MF $0.50

The internal friction of bell metal and wood is of general interest not only from the standpoint of material testing but also for providing a physical explanation of the musical properties of these materials. An electrodynamic type apparatus was used to excite freely suspended rod samples in the longitudinal, bending and torsional modes of vibration at low levels of stress amplitude over the audible frequency range. The techniques of loss factor measurements are described. Experimental results are presented which verify a relaxation-type behavior in the losses of bell metal due to intercrystalline heat flow. Measurements on five different types of wood indicate the general behavior of losses associated with Young's modulus and shear for propagation in rods oriented along the grain. The losses of one cross-grain specimen are reported. Dependence of losses on amplitude of applied stresses, rod geometry and moisture content (in wood) are observed and noted. Author (TAB)

N66-33786# Lockheed Missiles and Space Co., Palo Alto, Calif.

AXISYMMETRIC VIBRATION MODES OF THIN CONICAL SHELL

E. R. Kol'man [1965] 12 p refs Transl. into ENGLISH from Rasch. na Prochn. i Zhestk., Mashgiz, (Moscow), 1965 p 49–60

The differential equations of the natural vibrations of a thin circular conical shell are considered, and the axisymmetric vibrations of a shell are examined. It is shown that the frequency of natural axisymmetric vibrations of a conical shell depends on the relative thickness of the shell, and further, that the vibration frequency is nearly independent of the conditions of the fixed base. D.T.

N66-33788# Lockheed Missiles and Space Co., Palo Alto, Calif.

NATURAL VIBRATIONS OF SPHERICAL SANDWICH SHELLS WITH FREELY SUPPORTED AND FIXED EDGES

V. G. Suvernev [1965] 10 p refs Transl. into ENGLISH from Raschety Elem. Aviats. Konstr. (USSR), no. 3, 1965 p 219–225

The natural modes of vibration of shallow, elastic, sandwich spherical shells with a structure nonsymmetrical in the thickness of the outer layers were investigated. The filler was assumed to be rigid and transversally isotropic; and the carrying layers were isotropic and fabricated from different materials. A comparison was performed of the results of analyzing the fundamental frequencies of vibration for spherical shells with fixed and freely supported edges. The natural modes of vibrations of shells in the absences of external forces and in the presence of a transverse uniform pressure were also studied. D.T.

N66-33792# Lockheed Missiles and Space Co., Palo Alto, Calif.

STABILITY OF A CYLINDRICAL SHELL WITH ELASTIC FILLER UNDER EXTERNAL RADIAL PRESSURE

B. A. Korbut and S. G. Saksonov [1966] 10 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Aviats. Tekh. (Kazan), no. 2, 1966 p 38–43

The results are presented of solutions to the linear and nonlinear problems of the stability of a medium-length cylindrical shell with an elastic filler subjected to uniform external radial pressure. The deformations were assumed to be elastic, and the filler was simulated by a Winkler foundation. The boundary conditions corresponded to hinged support admitting of radial displacements. D.T.

N66-33795# Lockheed Missiles and Space Co., Palo Alto, Calif.

ON THE STABILITY OF CONICAL SHELLS UNDER AXIAL COMPRESSION

V. G. Karnaukhov Jul. 1966 10 p refs Transl. into ENGLISH from Prikl. Mekhan. i Tekhn. Fiz. (USSR), v. 2, no. 5, 1966 p 65–70

An exact solution in degenerate hypergeometric functions is given for the problem of stability of conical shells under the effect of longitudinal compressive stress resultants distributed uniformly over the endplate sections. Axisymmetric buckling is assumed in investigating the stability of an orthotropic shell. The general case of non-axisymmetric buckling is examined in the case of an isotropic shell. An asymptotic solution is presented, where the asymptotic behavior of combinations of degenerate hypergeometric functions for large values is used. Author

N66-33796# Lockheed Missiles and Space Co., Palo Alto, Calif.

ON THE NATURAL VIBRATIONS OF A TWO-LAYER CIRCULAR CYLINDRICAL SHELL WITH ELASTIC CONNECTORS

V. I. Ilyshev Jul. 1966 9 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Mashinostro. (Moscow), no. 3, 1966 p 30–35

The natural vibrations of a system of two closed coaxial circular cylindrical shells of different thickness which are interconnected by a sufficiently large number of identical equally-spaced, elastic rods are considered. The materials of the shells and the elastic connectors are assumed to be different and isotropic, and the rods are assumed to be absolutely stiff in shear and tension. The Kirchhoff–Love hypothesis is applied to the outer and inner shells. Variational calculus is used to obtain a system of five partial differential equations of the twelfth order. The concept of energy error is used to establish the domains of applicability of simplifications of the system of the vibrations equations and the spreading of the rod energy. N.E.N.

N66-33797# Lockheed Missiles and Space Co., Palo Alto, Calif.

NATURAL BENDING–TWISTING VIBRATIONS OF A FREE BEAM OF VARIABLE MASS AND STIFFNESS UNDER CONCENTRATED LOADINGS (I)

K. Ia. Kukhta Jul. 1966 11 p refs Transl. into ENGLISH from Dopov. Akad. Nauk Uk. RSR (Kiev), no. 4, 1966 p 441–447

The natural frequencies and the bending–twisting vibration modes of a beam were determined for the most general case, when the stiffness axis does not coincide with the axis of the beam centers of gravity and the centers of gravity of the concentrated loads do not lie on the stiffness axis. It was assumed that the natural frequencies and the vibration modes remain constant, whether the beam ends are fixed or are free. It is noted that the computational method used is convenient for computer programming. D.T.

N66-33798# Lockheed Missiles and Space Co., Palo Alto, Calif.

VIBRATIONS OF FLEXIBLE HOSES FILLED WITH A MOVING FLUID (FUEL)

V. A. Svetlitskii Jul. 1966 12 p refs Transl. into ENGLISH from Izv. Vysshikh Ucheben. Zavedenii, Mashinostro. (Moscow), no. 3, 1966 p 22–30

The small vibrations of flexible, inextensible hose, with a constant cross section, filled with a flowing ideal fluid were studied; and the vibration frequencies of the hose relative to the equilibrium plane were determined along with the rate of perturbation wave propagation. It was assumed that the three-dimensional shape of the hose is known and that this shape is practically independent of the effective forces of the moving fluid. In addition, it was assumed, for the motion of systems with zero bending stiffness, that the equilibrium mode of the system is entirely determined by the effective forces and that it is not known in advance. D.T.

N66-33800# Lockheed Missiles and Space Co., Palo Alto, Calif.

INFLUENCE OF THE BOUNDARY CONDITIONS ON THE FREE VIBRATIONS FREQUENCY AND MODES OF A CONICAL SHELL

E. R. Kol'man Jul. 1966 10 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Mashinostro. (Moscow), no. 3, 1966 p 178–183

The numerical solution of the total differential equations of the free vibration of thin conical shells with six variants of boundary conditions is presented. Some deductions made are: (1) The least free-vibration frequency of the truncated conical shells is almost independent of the conditions imposed on the angle of rotation of the tangent to the generator at the shell edge. (2) Conditions imposed on the tangential displacements of the shell edges exert an essential influence on the value of the least frequency. (3) Boundary condition influence on the value of the free-vibration frequency is large for axisymmetric vibrations, and drops as the number of circumferential waves grows. It is felt that the numerical solution reported shows that the value of the minimum free-vibration frequency for a conical shell depends on the boundary conditions for the tangential components of the displacements. R.Li.

N66-33814# Army Natick Labs., Mass. Clothing and Organic Materials Div.

PHOTOGRAPHIC STUDY OF STRESS WAVE PROPAGATION AND CRACK GROWTH IN A TRANSPARENT PLASTIC Interim Progress Report, Nov. 1964–Aug. 1966

Anthony F. Wilde and John J. Ricca 5 May 1966 34 p refs *Its* Tech. Rept.-66-46-CM
(C&OM-19; AD-633891) CFSTI: HC $2.00/MF $0.50

In order to develop techniques for studying the transient behavior of plastic materials subjected to mechanical impact, a preliminary photographic investigation was undertaken with an electronic image converter camera system. Two types of events were recorded with CR-39 plastic serving as the specimen material: stress pulses, produced in the plastic by mechanical impaction, were studied by observation of the resulting fringe patterns. The pulse fronts were characterized in terms of shape and propagation velocity. An empirical equation was derived to express the decrease in slope of segments of the pulse front as it propagated through the specimen. Propagating cracks, generated in the plastic by mechanical impact, were subjected to photographic analysis. Crack propagation velocities and estimated crack initiation times were obtained. These served to yield a rough estimate of the magnitude of the incident longitudinal pulse level at which crack initiation occurred.
Author (TAB)

N66-33841# J. G. Engineering Research Associates, Baltimoore, Md.
ORDER OF MAGNITUDE OF RADIATION FROM TURBULENT FLOW AND TURBULENCE EXCITED STRUCTURAL VIBRATION
Joshua E. Greenspon Dec. 1965 27 p refs Prepared for DTMB
(TR-8; AD-634036) CFSTI: HC $2.00/MF $0.50

Expressions are derived for the cross spectral density of the far field pressure resulting from the vibration of an elastic surface excited by turbulence and from a rigid surface over which there is turbulent flow. The plate problem is worked out in detail and it is shown that for frequencies of the order of the resonance of the lowest plate modes the radiation is due primarily to elastic vibration., whereas at high frequencies corresponding to higher resonant modes in the plate the turbulent flow alone can be responsible for part of the radiation. The basic formulas are also derived for the cylinder.
Author (TAB)

N66-33858# Lehigh Univ., Bethlehem, Pa. Fritz Engineering Lab.
THE SUBASSEMBLAGE METHOD OF DESIGNING UNBRACED MULTI-STORY FRAMES
J. Hartley Daniels and Le-Wu Lu Mar. 1966 102 p refs Sponsored by Navy and Welding Res. Council
(Rept.-273.37; AD-633800) CFSTI: HC $4.00/MF $0.75

A new method is presented for the design of columns and girders in unbraced multi-story steel frames which are subjected to combined horizontal wind loads and distributed gravity loads. The method is based on the concept of sway subassemblages and considers the elastic plastic behavior of girders, the instability of the beam-columns, and second order effects (caused by P-Δ moment) on the structure. It employs a semi-graphical solution using specially prepared charts to develop the complete horizontal load-deflection relationship for each story designed. A design procedure is proposed, and and illustrative example is included to demonstrate the technique developed.
Author (TAB)

N66-33859# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SLANTING SHELLS OF ROTATION OF VARIABLE THICKNESS IN SPATIAL TEMPERATURE FIELD
A. D. Kovalenko 21 Jan. 1966 23 p refs Transl. into ENGLISH from Prikl. Mekhan. (USSR), v. 6, no. 3, 1960 p 241-249 Presented at All Union Conf. on Theoret. and Appl. Mech., 1 Feb. 1960
(FTD-TT-65-1376/1+2+4; TT-65-61419; AD-633817) CFSTI: HC $1.00/MF $0.50

A thermoelastic problem of a variable thickness slanting shell of rotation in a spatial temperature field is discussed. The shell material is described by a system of two fourth order differential equations in partial derivatives. In this case the place of the surface center of the shell is considered a so-called initial surface. Consideration is given to the elasticity modulus variability, the general elongation rigidities, bending, and pure thermal forces and moments.
C.T.C.

N66-33970*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
THERMAL DISTORTIONS OF THIN-WALLED PARABOLOIDAL SHELLS
Joseph E. Walz Washington, NASA, Aug. 1966 45 p refs
(NASA-TN-D-3543) CFSTI: HC $2.00/MF $0.50 CSCL 20K

Equations are presented to describe the linear behavior of a deep thin-walled shell of revolution subjected to an axisymmetric thermal loading. A solution is obtained for a paraboloid with a ring at the edge. Results are plotted showing the rotation of the tangent to the shell due to (1) constant temperature difference between shell and ring and (2) constant temperature gradient through the thickness of the shell.
Author

N66-34022# Navy Mine Defense Lab., Panama City, Fla.
THE THEORETICAL PRESSURE WAVEFORM IN A LAYERED MEDIUM DUE TO A SERIES OF IMPULSES Interim Report
A. S. Victor and E. G. Mc Leroy May 1966 31 p refs
(I-99; AD-633964) CFSTI: HC $2.00/MF $0.50

The extension made by Spitznogle to include a complex air-fluid two-layer elastic solid system in Strick's theory of the propagation of elastic waves from an impulsive source along a fluid-solid interface has been further expanded. In the previous work the source-function considered was a single impulse. This has been replaced (in the present work) by a source-function which is a series of such impulses. Theoretical waveforms are computed for an air-water-glass-aluminum model and various impulsive source-functions ranging from the single impulse to a sequence of impulses of various magnitudes and spacings in time.
Author (TAB)

N66-34033# Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
PRESSURE DISTRIBUTION ON UNDERGROUND STRUCTURAL CYLINDERS Technical Report, 1 Mar. 1964-2 Apr. 1965
Kaare Hoeg Kirtland AFB, N. Mex., AF Weapons Lab., Apr. 1966 157 p refs
(Contract AF 29(601)-6368)
(AFWL-TR-65-98; AD-631671) CFSTI: HC $5.00/MF $1.00

The objective of this study was to investigate the magnitude and distribution of radial contact pressures on a horizontally buried structural cylinder under the action of a uniform static overpressure applied on the soil surface. A computational procedure was developed for predicting these contact pressures and a parallel experimental phase, which constituted the major effort in this study, was conducted. The tests were designed to measure directly the radial pressure on the cylinder

interface. The primary variables investigated were cylinder flexibility, cylinder compressibility, depth of sand cover, and magnitude of applied surface pressure. The approach taken in the analytical phase was to analyze an idealized representation of the soil-structure system by a closed mathematical formulation which assumed the soil to behave like a continuous, elastic medium. Simple modifications of the mathematical model were introduced to make it more realistically represent a structural cylinder buried in soil. The final distribution of stresses and displacements was computed in a step-wise linear fashion over the pressure range to account for the nonlinear stress–strain relationship for sand. The experimental and analytical results were compared to each other and to previous semi-empirical recommendations for the design of underground structures. It was concluded that the analytical formulation provides an extremely useful approach to the design of underground structural cylinders in general.

Author (TAB)

N66-34049# Army Engineer Waterways Experiment Station, Vicksburg, Miss.

THE ELASTIC RESPONSE OF BURIED CYLINDERS IN SAND

R. E. Walker, G. E. Albritton, and T. E. Kennedy Jun. 1966 15 p refs Presented at Army Sci. Conf., West Point, N. Y., 14–17 Jun. 1966

(AD-634648) CFSTI: HC $1.00/MF $0.50

The results of the study indicate that there are certain regimes where the elastic theory could be used to determine the dynamic magnification factors. Further, elastic theory does not appear to be applicable over the entire pressure domain nor does it appear to predict the location of the maximum strain. A majority of the observed phenomena may be explained by the fact that the static transmissibility of the soil increases in higher pressure regions and by the fact that the dynamic transmissibility is higher than the static for the low pressure region. Both the static and dynamic transmissibilities seem to converge in the higher pressure regions.

Author (TAB)

N66-34054# Ses-Space Systems, Inc., Torrance, Calif.

SFAB BALLOON FLIGHTS: EXPERIMENTAL BALLOONS FABRICATED WITH S-FAB POLYPROPYLENE TRI-LAMINATE FILM Final Report

Dale W. Cox Apr. 1966 16 p

(Contract Nonr-4775(00))

(SSS-4041; AD-633603) CFSTI: HC $1.00/MF $0.50

Flight and technical data on two experimental balloons fabricated from a new balloon film, S-FAB, is presented. S-FAB is a tri-laminate of polyethylene/polypropylene/polyethylene.

Author (TAB)

N66-34070*# Oklahoma State Univ., Stillwater. School of Mechanical Engineering.

[RESEARCH ON A SELF-TEMPERATURE REGULATING SPACECRAFT SKIN SYSTEM] Progress Report, Dec. 1, 1965–May 31, 1966

J. A. Wiebelt Jun. 1966 26 p refs

(Grant NsG-454)

(NASA-CR-77101) CFSTI: HC $2.00/MF $0.50 CSCL 22B

The use of moveable bimetallic thermostatic fins were investigated for spacecraft surface temperature control. Thermal coupling of the fin system to the solar radiation was found rather than to the simulated spacecraft skin, and the control of surface properties was dependent on solar environment rather than spacecraft skin temperature. A close correspondence between the calculated net energy loss and the measured net energy loss was found when tests were made without solar input. Experimental runs were made with and without a shielding over a small gap between base plate and the insulating box. Large error in calculated values for the simulated solar energy input runs was identified with the solar energy analysis and experimental techniques.

N.E.N.

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N66-32715*# Brown Engineering Co., Inc., Huntsville, Ala. Research Labs.

EXPERIMENTAL TRANSIENT THREE-DIMENSIONAL HEAT TRANSFER ANALYSIS

Roy W. Blanton, Jr. and J. Wayne Littles May 1965 68 p refs (Contract NAS8-5289)

(NASA-CR-67510; R-145) CFSTI: HC $2.50/MF $0.75 CSCL 20M

A comparison of calculated data with data obtained experimentally was made to verify calculated values for a transient heat transfer program in which a bank of quartz T-3 230 volt infrared lamps was used as an energy source. A computer model was developed, and boundary conditions obtained during tests were input for several cases; the energy outputs of an asymptotic calorimeter and of iron–constantan thermocouples of an aluminum channel at specified locations were recorded. A variation in temperature tolerance of up to 2.5 degrees was noted during the investigation for identical points. Results compared showed excellent correlation for the physical configuration and boundary condition selected. The capability of the test program to handle a total heat flux input as a function of time was verified.

R.Li.

N66-32717*# Lockheed Missiles and Space Co., Sunnyvale, Calif.

STUDY OF HEAT SHIELDING REQUIREMENTS FOR MANNED MARS LANDING AND RETURN MISSIONS Final Report

L. W. Woodruff, W. D. Colemen, and L. F. Hearne Sep. 1965 115 p refs *Its* Rept.-4-74-65-1

(Contract NAS2-1798)

(NASA-CR-68147) CFSTI: HC $3.00/MF $0.75 CSCL 20M

A parametric description of heat shielding requirements for entry into the earth atmosphere at hyperbolic speed is presented for two lifting vehicles of the biconic configuration class. In addition, detailed predictions of shield material response are provided for several prescribed test environments. Approximately 50 separate cases were studied to obtain parametric results for heat shield weights over the entry velocity range from 36,000 ft/sec to 65,000 ft/sec. Shielding requirements are greatest and relatively insensitive to entry velocity in the overshoot entry mode. Significant weight penalty is associated with the use of higher lift to increase entry-corridor width. As compared with vehicle geometries previously

considered, the slender biconic configurations require appreciably greater shielding than do blunter configurations. The environmental uncertainty most affecting the predicted shielding requirements is boundary layer transition. Radiative heat transfer is unimportant even at the highest velocities considered. The extent of blunting of the initially sharp noses during entry is small and should cause no adverse thermal effect. Author

N66-32723*# Dynatech Corp., Cambridge, Mass.
THERMOPHYSICAL PROPERTIES MEASUREMENTS PERFORMED FOR NASA
Harris L. Traiger and Ralph L. Wentworth 27 Aug. 1964 21 p *lts* Rept.-493
(NASA Order L-48876)
(NASA-CR-60042) CFSTI: HC $1.00/MF $0.50 CSCL 20M

A test program is reported on thermal conductivity, specific heat, and density measurements of plastic material samples over a range of 75° to 300°F. Comparisons of thermal conductivity and specific heat values indicate that a transition point is present at about 175°F, since each curve displays a discontinuity in slope at this temperature. The thermal conductivity curve shows a difference in values at the transition point of 5.5%. Results indicate that the specific heat curve has a slowly increasing slope to about 165° F, falls until it reaches 200°F, and then slowly rises up again, and that correlation between the two sets of data is consistent. R.LI.

N66-32762*# Southern Methodist Univ., Dallas, Tex.
HEAT TRANSFER ACROSS SURFACES IN CONTACT: PRACTICAL EFFECTS OF TRANSIENT TEMPERATURE AND PRESSURE ENVIRONMENTS Semiannual Report, 1 Oct. 1965–1 Apr. 1966
H. A. Blum and C. J. Moore, Jr. [1966] 40 p *ref*
(Grant NsG-711)
(NASA-CR-76878) CFSTI: HC $2.00/MF $0.50 CSCL 20M

Experimental and theoretical studies of heat transfer across surfaces under transient conditions are reported. Work during the period October, 1965, through March, 1966, centered on design modifications for the contact cylinders that provide axial force control in a closed loop electro-hydraulic servomechanism, test runs with aluminum and stainless steel samples, and a numerical solution for the two dimensional heat transfer of a single cylinder in contact with a plate and subjected to changes in resistance and thermal environment. Obtained transient heat conductance values for hot–cold pairs of aluminum samples pressed together at constant contact pressure until steady state had been reached, compared well with earlier established values. A passive thermal control device, consisting of two cylinders with small gaps between their contacting surfaces, was developed and used to obtain variations in heat flux for a change in temperature of the hotter piece of the control device. Power input versus temperature plots from cylinder thermocouples seem to indicate that the device works better at higher temperatures. G.G.

N66-32804*# Illinois Univ., Urbana. Engineering Experiment Station.
AN EXPERIMENTAL AND THEORETICAL INVESTIGATION OF THE THERMAL CONTACT RESISTANCE Final Report
A. M. Clausing Jul. 1966 81 p *refs*
(Grant NsG-242-62)
(NASA-CR-76807; ME-TN-242-3) CFSTI: HC $2.50/MF $0.75 CSCL 20M

For predicting thermal contact resistance in a vacuum environment, a restrictive analysis based on a model of macroscopic elastic contact between mating members was conducted. Three resistances in series were considered: the macroscopic constriction resistance, the microscopic constriction resistance, the microscopic constriction resistance, and the film resistance. Preliminary calculations showed that the macroscopic resistance was of major importance. The model has three dimensionless parameters for correlating data: the Biot nodulus, the elastic conformity modulus, and the interstitial conductance. It was concluded that the model indicates the effect of the many parameters, and provides a means of designing high or low resistance interfaces; it also indicates if accurate predictions are possible. M.G.J.

N66-32806# Iowa State Univ. of Science and Technology, Ames.
THERMODYNAMIC PROPERTIES OF CALCIUM–ZINC ALLOYS
Ralph Julius Hecht (M.S. Thesis) Feb. 1966 65 p refs
(Contract W-7405-ENG-82)
(IS-T-76) CFSTI: HC $3.00/MF $0.75

The dewpoint and Knudsen effusion methods were used to determine the equilibrium vapor pressure of zinc over solid and liquid calcium–zinc alloys. For each alloy these data were fitted to a linear equation giving the logarithm of pressure as a function of temperature. The vapor pressure data for the liquid alloys were combined with the vapor pressure of pure zinc to determine expressions for the relative excess partial molal free energy, enthalpy, and entropy for both components. The integral free energy, enthalpy, and entropy of solution for the calcium–zinc alloys were calculated from these expressions. Vapor pressure data of zinc over the solid alloys were used to calculate expressions for the standard free energy of formation of the calcium–zinc compounds for the temperature range 298 to 1123°K.
Author (NSA)

N66-32854# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.
PHYSICAL MODEL OF HEAT TRANSFER BEYOND THE CRITICAL HEAT FLUX
E. P. Quinn Jan. 1966 41 p refs
(Contract AT(04-3)-189)
(GEAP-5093; EURAEC-1603) CFSTI: HC $2.00/MF $0.50

A physical model of fully-developed film boiling, space-dependent film boiling, and transition boiling for high-pressure forced water flow is analyzed and compared to experimental measurements. An analytical expression is given for the heat transfer from the wall to superheated steam phase in film boiling. Empirical coefficients are shown for the heat transfer between the steam phase and entrained droplets. A relation is given for estimating overall heat transfer coefficients for fully-developed film boiling. Spatially-dependent film boiling is examined and found to be a result of boundary layer and bulk steam phase superheat development. Author (NSA)

N66-32894# Beers (Roland F.), Inc., Alexandria, Va.
POSSIBILITIES OF SECONDARY EXPLOSIONS AND POST-SHOT THERMAL EFFECTS IN CAVITIES IN TUFF
Sherwood B. Smith 15 Apr. 1966 35 p refs
(Contract AT(29-2)-1163)
(NVO-1163-70) CFSTI: HC $2.00/MF $0.50

Using the Rainier event as a model, early post-shot analyses were made to evaluate the effect of possible entry of water into a cavity and to determine the effect of thermal implosion of surface material from the cavity walls. Analyses indicate that entry of water into a cavity in tuff could cause only a relatively small increase in cavity steam pressure and would not constitute a hazard. The thermal implosion of wall surface material into the cavity would result in rapid cooling of contained steam and a decrease in pressure (except for a relatively small initial increase). In Antler, it appears that venting was caused by entry of heated explosion products into

the access tunnel in combination with entry of water into the access drift at about the same time. The water was converted to steam at sufficient pressure to produce stemming failure and venting. However, provision of adequate stemming should reduce this hazard to a minimum. NSA

N66-32921# Minnesota Univ., Minneapolis. Dept. of Mechanical Engineering.

HEAT AND MASS EXCHANGE IN THE SUPERSONIC BASE REGION

C. J. Scott and E. R. G. Eckert *In* AGARD Separated Flows, Pt. I May 1966 p 429-478 refs (See N66-32906 19-12) CFSTI: HC $5.53/MF $2.50

New turbulent mixing layer solutions are presented involving parametric variations of Mach number, recirculation zone temperature, and turbulent analysis by requiring that the predicted adiabatic recirculating zone temperatures agree with experimental results. The model selected for the wall film is a conventional, laminar stagnation point flow. This assumption excludes rearward steps from this analysis. The two analyses are combined by equating surface heat and mass transfer rates (the analysis also includes distributed wall mass transfer). Recirculation zone-wall temperature differences are computed which compare favorably with experiments. New experimental base pressure and heat flux measurements also support the two-layer analysis in the absence and presence of surface mass transfer. Author

N66-32938# Boeing Co., Seattle, Wash. Missile and Information Systems Div.

THEORETICAL ANALYSIS OF LAUNCH VEHICLE BASE FLOW

R. J. Dixon and R. H. Page *In* AGARD Separated Flows, Pt. 2 May 1966 p 911-940 refs (See N66-32926 19-12) CFSTI: HC $4.95/MF $2.25

An analytical model of the flow field at the base of a vehicle with propulsion nozzles has been developed. The model has been used to calculate the heat transfer at the base stagnation point. The pressure distribution and other flow field parameters are also determined for the base region. The theoretical analysis and a typical comparison with experimental data are presented. Author

N66-32946*# National Aeronautics and Space Administration, Washington, D. C.

PROCEEDINGS OF CONFERENCE ON ACTIVE TEMPERATURE CONTROL

Conrad P. Mook [1964] 92 p refs Conf. held at NASA Headquarters, 9 Apr. 1964
(NASA-TM-X-56165) CFSTI: HC $2.50/MF $0.75 CSCL 20M

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8. TEMPERATURE CONTROL LOUVERS FOR THE MARINER VENUS AND MARINER MARS SPACECRAFTS M. Gram (JPL) 6 p (See N66-32954 19-33)

N66-32947*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.

ACTIVE THERMAL CONTROL OF THE MICROMETEOROID CAPSULE ELECTRONICS

Tommy C. Bannister *In* NASA, Washington Proc. of Conf. on Active Temp. Control [1964] 8 p (see N66-32946 19-33) CFSTI: HC $2.50/MF $0.75

A system of louvers is described which will provide active thermal control for temperature sensitive elements in the electronics canister of the micrometeoroid capsule. The louvers are positioned so as to eliminate incident solar radiation. Heat transfer through the louvers is strictly infrared radiant transfer to the vehicle acting as a heat sink. Time spent in sunlight by the spacecraft is graphically shown, and a minimum of four major actuations by the louvers is expected. The louver actuators are composed of bimetallic spirals which actuate each louver blade independently and are thermally isolated from the structure and sink by a special superinsulated housing. The free end of the blade rides in a Teflon bushing to prevent cold welding and to reduce friction. E.A.O.

N66-32948*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

CAPILLARY SCREEN PUMP IN A FORCED CONVECTION SYSTEM

Thomas O. Thostesen *In* NASA, Washington Proc. of Conf. on Active Temp. Control [1964] 9 p refs (See N66-32946 19-33) CFSTI: HC $2.50/MF $0.75

A convection loop system using vapor pressure and surface tension forces for fluid transport in removing excess heat in large, densely packed spacecraft is described. The thermal energy is transferred by evaporation of a fluid at the heat source and condensation at the heat sink. In the proposed system the fluid is retained and moved by the surface forces generated in the meniscii formed by a screen mesh. Preliminary tests were run with water as the fluid at one atmosphere. It was found that the mesh screen would evaporate water at a thermal rate of 20 watts at 156°F against zero head, and condense water at a thermal rate of 75 watts. Tests on the evaporator in a vacuum showed a maximum evaporation rate of 3 watts, with the limitation imposed by catastrophic evaporation behind the screen in the liquid space. Bubble formation is regarded as a main problem for system operation. E.A.O.

N66-32949*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

THE USE OF RADIATION SHIELDS FOR THERMAL CONTROL OF VEHICLES ON THE LUNAR SURFACE

John C. Arvesen *In* NASA, Washington Proc. of Conf. on Active Temp. Control [1964] 14 p (See N66-32946 19-33) CFSTI: HC $2.50/MF $0.75

The thermal environment of the moon is briefly reviewed, and conclusions are first drawn for the case of an unshielded vehicle. Among the listed sources of heat affecting the vehicle are hot lunar surface radiation, direct solar radiation, reflected solar radiation, and internally generated heat. A lunar vehicle configuration, consisting of a conical and a cylindrical section, is given to evaluate the effects of these heat inputs. Temperature calculations for the vehicle are then made while assuming it to be at the subsolar point and when it receives side illumination. For a shielded vehicle, three different shield configurations for use at the subsolar point are demonstrated. It is pointed out that it is difficult to calculate the temperatures of a shielded vehicle because of the large number of surfaces involved. Temperature effects on the conical and cylindrical sections of the shielded vehicle for the subsolar point position and while receiving side illumination are then analyzed. It is concluded that shields provide a high degree of isolation from an external thermal environment. K.W.

N66-32950*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

DISCUSSION OF THE OKLAHOMA STATE UNIVERSITY ACTIVE TEMPERATURE CONTROL SYSTEM

Robert E. Kidwell, Jr. *In* NASA, Washington Proc. of Conf. on Active Temp. Control [1964] 15 p refs (See N66-32946 19-33) CFSTI: HC $2.50/MF $0.75

An active temperature control device consisting of pairs of bimetallic strips mounted back-to-back on a surface representing the skin or radiating surface of a spacecraft is described. At a specified temperature the bimetallic strips are straight and perpendicular to the surface. Mounting surface and bimetallic strips differ in reflectance, and a temperature-caused bending of the bimetallic elements results in a reduction of the effective emittance of the total surface. A deflection equation is given, and determination of the effective solar reflectance value is discussed. The reflectances of two coating materials, evaporated aluminum and white paint, and the effective reflectances of the combination as a function of wavelength are shown in diagrams. An analysis of heat dissipation characteristics was made, and net heat flux is plotted as a function of solar polar angle, with fin temperature as a parameter. Also given is the surface temperature as a function of solar polar angle for a fixed internal heat dissipation of 37.5 BTU/hr-ft^2. K.W.

N66-32951*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

CONTROLLABLE α/ϵ RATIO SURFACES FOR TEMPERATURE REGULATION OF SPACECRAFT

William J. O'Sullivan, Jr. *In* NASA, Washington Proc. of Conf. on Active Temp. Control [1964] 13 p refs (See N66-32946 19-33) CFSTI: HC $2.50/MF $0.75

Given are the technical background defining the problem, the possible solutions found from application of electomagnetic and quantum mechanics theory, the classification of the potential solutions by method of operation into thermotropic and nonthermotropic types, and the experimental research program outline. Phase I aimed at obtaining basic data on the phenomena. Phase II aimed at engineering development of the most promising methods, details of operation of the change in transparency method representing the most successful thermotropic method found to date, and details of the electroluminescence method representing the most successful nonthermotropic method found to date. Author

N66-32952*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

PHASE CHANGE IN POLYMERIC SYSTEMS FOR ACTIVE THERMAL CONTROL

Warren C. Kelliher, George F. Pezdirtz, and Philip R. Young *In* NASA, Washington Proc. of Conf. on Active Temp. Control [1964] 11 p refs (See N66-32946 19-33) CFSTI: HC $2.50/MF $0.75

Self-contained coatings which can be made to vary their absorptance of solar radiation at predesigned temperature levels were studied. Of several combinations and permutations of vehicles, pigments, and compositions, polystyrene and polyethylene-polyvinyl acetate vehicles were found to produce the best coating from considerations of their physical and optical properties when used with such pigments as eicosane or paraffin. The coatings were prepared by heating the thermoplastic vehicle and blending in molten pigment until a homogeneous solution resulted. Sheets 10 to 20 mils thick were cast onto a highly polished silver plate. Solar absorptance, thermal emittance, and spectral reflectance of the coatings were measured. Phase transition temperatures were measured by differential thermal analysis. It was noted that the change in transparency of the two coatings with the same pigment, paraffin, was influenced by the nature of the vehicle. K.W.

N66-32953*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

RESEARCH ON ACTIVE TEMPERATURE CONTROL AT GODDARD SPACE FLIGHT CENTER

Stanford Ollendorf *In* NASA, Washington Proc. of Conf. on Active Temp. Control [1964] 10 p (See N66-32946 19-33) CFSTI: HC $2.50/MF $0.75

Considerations governing the thermal design of in-house spin-stabilized satellites, for which temperature control is achieved primarily by passive means, are listed. Structural configurations, orbit trajectories, internal power dissipation, sun-spin axis angles, and shadow periods are among the factors that are discussed. The need for active temperature control on future satellites, expected to become necessary because of greater complexity, is pointed out. The use of louvers, internal canisters, and internal shutters in existing active control systems is discussed. Spacecraft internal temperature control by means of rotary blades mounted on the skin is mentioned. Active temperature control problems peculiar to Goddard spacecraft, such as high packaging density and the inability to mount a louvered or internal shutter system, are briefly pointed out. Work on an improved version of the rotary blade controller, employing a bimetallic coil and impregnated nylon thrust bearings, is mentioned. K.W.

N66-32954*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

TEMPERATURE CONTROL LOUVERS FOR THE MARINER VENUS AND MARINER MARS SPACECRAFTS

M. Gram *In* NASA, Washington Proc. of Conf. on Active Temp. Control [1964] 6 p (See N66-32946 19-33) CFSTI: HC $2.50/MF $0.75

Dissimilarities in configuration, and mechanical and functional similarities, of the louver systems designed for Mariner R and Mariner C are listed and compared. Thermal performance for the two systems in terms of the effective emittance as a function of louver blade angle is given, and theoretical performance values are included for comparison. In order to rationalize empirical and theoretical performance, an adjustment was made to the empirical values for the fully

closed louver condition. The adjusted thermal performance figures are only in fair agreement with the theoretical values, which is attributed mainly to experimental errors made during measurement of louver performance and also to the inexact nature of the mathematical model. Author

N66-33031# United Kingdom Atomic Energy Authority, Risley (England). Reactor Group.

CALCULATION OF FLOW RESISTANCE OF PASSAGES BOUNDED BY A COMBINATION OF ROUGH AND SMOOTH SURFACES

D. Wilkie and L. White 1966 38 p refs
(TRG-1113(W))

A set of equations is derived which forms the basis of a method of applying transformed roughened-surface friction-factor data to the calculation of mixed-surface pressure drop. Detailed examples of the method applied to annular and cluster configurations are presented, and the results are compared with experimental values. Author

N66-33034# United Kingdom Atomic Energy Authority, Harwell (England). Chemical Engineering Div.

REPORTS ON TWO-PHASE HEAT TRANSFER ISSUED BY A.E.R.E., HARWELL

L. B. Cousins May 1966 24 p refs
(AERE-BIB-150) HMSO: 3s

This paper lists and summarizes the reports and publications issued by the two-phase heat transfer section of the Chemical Engineering Division. The reports are divided into two main sections: (1) Burnout and heat transfer studies on steam–water systems. (2) Hydrodynamic studies on air–water systems. Author

N66-33077# Joint Publications Research Service, Washington, D. C.

STUDIES IN PHYSICS OF COMBUSTION AND EXPLOSION (NO. 4, 1965)

25 Jul. 1966 84 p refs Transl. into ENGLISH from Fiz. Goreniya i Vzryva (Novosibirsk), no. 4, 1965 p 20–23, 31–51, 63–84
(JPRS-36674; TT-66-33105) CFSTI: $3.00

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2. SLIDING OF DETONATION AND SHOCK WAVES ON A LIQUID SURFACE A. A. Borisov, S. M. Kogarko, and A. V. Lyubimov p 7–17 refs (See N66-33079 19-33)

3. THE IGNITION OF CONDENSED SYSTEMS BY RADIANT ENERGY V. N. Vilyunov and O. B. Sidonskiy p 18–24 refs (See N66-33080 19-33)

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5. THE PROPAGATION OF WAVES IN A BOUNDED ELASTIC–PLASTIC ROD IN A CASE OF LONGITUDINAL IMPACT G. G. Konstantinov, L. L. Marchenko, and K. N. Shkhinek p 35–44 ref (See N66-33082 19-32)

6. EXPERIMENTAL STUDY OF EXPLOSION STRESSES IN SOFT GROUND ON ENGINEERING STRUCTURES L. I. Koshelev, N. N. Popov, and P. I. Yartsev p 45–53 (See N66-33083 19-32)

7. EFFECT OF AN EXPLOSION ON MATTER: DYNAMIC COMPRESSION OF POTASSIUM NITRATE S. S. Batsanov, A. A. Deribas, Ye. V. Dulepov, M. G. Yermakov, and V. M. Kudinov p 34–60 refs (See N66-33084 19-06)

8. IGNITION OF POWDER BY A SHOCK WAVE Ye. Ye. Kiselev, A. D. Margolin, and P. F. Pokhil p 61–63 refs (See N66-33085 19-33)

N66-33078# Joint Publications Research Service, Washington, D. C.

STUDY OF CONTINUOUS DETONATION IN AN ANNULAR CHANNEL

V. V. Mikhaylov and M. Ye. Topchiyan *In its* Studies in Phys. of Combust. and Explosion (No. 4, 1965) 25 Jul. 1966 p 1–6 refs (See N66-33077 19-33) CFSTI: $3.00

A mixture of $2C_2H_2+5O_2$ was ignited in two chambers with internal diameters of the annular channel of 250 and 170 mm. The rate of rotation of the brightly glowing regions, the heads, was measured by photorecorder in one chamber with five rotating heads apparent, and in a second chamber with four or three heads. The velocity measurements show a relatively high stability of the process and an explicit tendency toward increase in velocity as the number of heads is decreased. The total compensation method was applied to study the structure of the glowing zone, for which the rotation of the photorecorder drum was synchronized with the velocity of the image. Diagrams of the luminescence structure are given. An attempt to improve the resolution in the recording of weakly glowing spots is also described. Pressure differences during the combustion process were measured with piezoceramic pickups and are shown in oscillograms. Pressure difference measurements jumped to 43 mm Hg at the outer edge of the channel and reached about 10 to 15 mm Hg before the shock waves. The combustion velocity observed during the experiments was approximately 900 m/sec. K.W.

N66-33079# Joint Publications Research Service, Washington, D. C.

SLIDING OF DETONATION AND SHOCK WAVES ON A LIQUID SURFACE

A. A. Borisov, S. M. Kogarko, and A. V. Lyubimov *In its* Studies in Phys. of Combust. and Explosion (No. 4, 1965) 25 Jul. 1966 p 7–17 refs (See N66-33077 19-33) CFSTI: $3.00

Two reaction regimes originating in the motion of a detonation wave on the surface of a liquid as a function of the ratio between the velocity of the detonation wave D and the speed of sound in the liquid c_1 are considered. The first regime occurs if $D>c_1$, the second $D<c_1$. A theoretical analysis of the factors affecting both conditions is presented. The behavior of the liquid in view of the tangential gap occurring in stability, with a consideration of the field of gravity and the forces of surface tension, is additionally analyzed. The experimental installation consisted of a chamber with two transparent side walls and a rectangular section of 27×28 mm and a length of 37 cm; the chamber was connected with a detonation tube. An electric spark set off the detonation in the tube. Reactions were recorded with a penumbra instrument combined with a photoregister or a motion picture camera. Used as explosives were $2H_2+NO_2$, CH_4+2O_2, oxygen, and air. Liquids used were water, glycerin, mercury, kerosene, and cetane. The experiments confirmed the instability of liquid or viscous surfaces under sliding detonations or shock waves. K.W.

N66-33080# Joint Publications Research Service, Washington, D. C.

THE IGNITION OF CONDENSED SYSTEMS BY RADIANT ENERGY

V. N. Vilyunov and O. B. Sidonskiy *In its* Studies in Phys. of Combust. and Explosion (No. 4, 1965) 25 Jul. 1965 p 18–24 refs (See N66-33077 19-33) CFSTI: $3.00

The simplest model of a condensed substance capable of thermic decomposition is considered. It is assumed that the summary-exothermic processes occurring in the condensed phase of the fuel are responsible for ignition. A light flux of constant intensity is assumed to fall on the surface of the fuel, leading to an acceleration of the chemical reactions and an additional liberation of heat in the fuel. After a certain time the flux of radiant energy ceases and an adiabatic is established at the surface. Differential equations for establishing the temperature variations at the surface, the dimensionless variables, pertinent parameters, and the boundary conditions are given. The equations were solved by the relaxation method with an electronic computer. Considered is also the case when, in addition to ignition, the quantitative relationships of the transition from ignition to steady-state combustion is to be determined. A solution for obtaining the temperature scale in case burning-out of the fuel is not considered is given. The effect of oscillation attenuation on burning rate is pointed out. K.W.

N66-33081# Joint Publications Research Service, Washington, D. C.

COMBUSTION OF CONDENSED MIXTURES WITH POLYDISPERSED COMPONENTS

S. A. Tsyganov, N. N. Bakhman, and V. V. Yevdokimov *In its* Studies in Phys. of Combust. and Explosion (No. 4, 1965) 25 Jul. 1966 p 25–34 refs (See N66-33077 19-33) CFSTI: $3.00

The quantitative relationships of the combustion of compositions with a bi-dispersed oxidizer were studied. Used were model mixtures of polystyrene, plexiglass, and bitumen with coarsely dispersed, finely dispersed, and mixed fine–coarse ammonium perchlorate. Most compositions were examined both as gelatinized and ungelatinized mixtures. The polymer was distributed during gelatinzation in the form of films on the surfaces of the oxidizer particles. The experiments were conducted with cylindrical charges having a diameter of 8 mm and a height of 8 to 10 mm, pressed into brass cases, in a constant-pressure bomb in nitrogen. Combustion times were measured with a piezoquartz pressure pickup and recorded on a loop oscillograph. Results of the experiments are presented in tabulated form. It was found that the combustion rate of a mixed oxidizer composition is usually not equal to the calculated value and may approach either that of a fine or a coarse mixture. A coarse oxidizer has little effect on the combustion rate unless a homogeneous mixture burns very slowly or is incapable of burning by itself. K.W.

N66-33085# Joint Publications Research Service, Washington, D. C.

IGNITION OF POWDER BY A SHOCK WAVE

Ye. Ye. Kiselev, A. D. Margolin, and P. F. Pokhil *In its* Studies in Phys. of Combust. and Explosion (No. 4, 1965) 25 Jul. 1966 p 61–63 refs (See N66-33077 19-33) CFSTI: $3.00

The samples, a mixture of nitroglycerin and nitrocellulose, were placed in a shock tube consisting of an air-filled low-pressure chamber and a high-pressure chamber filled with compressed nitrogen. The pressure in the reflected waves varied from 3 to 25 atmospheres, the temperatures from 500° to 1500°K. The powder was ignited with a delay of the order of a millisecond and at approximately 1000°K. An equation is given for determining the surface temperature of an ideally smooth powder surface, and calculations indicated the ignition temperature for such a powder to be 100°C. Irregularities in a surface, essential for ignition, were then calculated, and mirror-smooth samples were prepared to verify theoretical results. The mirror-smooth samples ignited in the shock tube only when a scratch was made on the surface. It was established that notwithstanding the chemical reaction during ignition, surface irregularities are of prime importance in the ignition of a powder. K.W.

N66-33124# Rome Univ. (Italy). Scuola di Ingegneria Aerospaziale.

RADIATIVE HEAT EXCHANGE BETWEEN CONCENTRIC SPHERES IN THE PRESENCE OF NON-UNIFORM TEMPERATURE AND EMISSIVITY [SCAMBIO TERMICO RADIATIVO TRA SFERE CONCENTRICHE IN PRESENZA DI TEMPERATURA ED EMISSIVITA' NON UNIFORMI]

Carlo Arduini Feb. 1966 52 p refs *Its* Atti del Centro Ric. Aerospaziali no. 12

CFSTI: HC $3.00/MF $0.50

Consideration is given to the problem of radiative heat exchange between a body and an enclosure when the temperature and the emissivity are not uniform on the surfaces. A series solution is presented, with the terms of the series deduced from the specified distribution, ϵT^4, through the application of particular integral operators. The explicit form of these operators is given for a centered two spheres system with axialsymmetric ϵT^4 distribution. A numerical example shows how the effect of the ϵT^4 disuniformity depends mainly upon the hemisymmetric components of the distribution. For these components the heat exchange decreases in the hotter points and increases in the cooler points. C.T.C.

N66-33144# National Bureau of Standards, Washington, D. C.

SELECTED VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES. PART 2: TABLES FOR THE ELEMENTS TWENTY-THREE THROUGH THIRTY-TWO IN THE STANDARD ORDER OF ARRANGEMENT

Donald D. Wagman, W. H. Evans, I. Halow, V. B. Parker, S. M. Bailey et al 6 May 1966 68 p ref

(NBS-TN-270-2) GPO: $0.40

Enthalpy and Gibbs energy of formation, and entropy and heat capacity properties are tabulated for silicon, germanium, tin, lead, boron, aluminum, gallium, indium, and thallium and their compounds. L.E.W.

N66-33180*# Michigan Univ., Ann Arbor. Heat Transfer and Thermodynamics Lab.

PRESSURIZATION OF LIQUID OXYGEN CONTAINERS Progress Report No. 7, Nov. 1963–Nov. 1964

J. A. Clark, H. Merte, Jr., W. J. Yang, E. Lewis, H. Barakat et al Jan. 1965 81 p refs *Its* Rept.-04268-9-P

(Contract NAS8-825)

(NASA-CR-63431) CFSTI: HC $3.00/MF $0.75 CSCL 20M

During this period a summary of the subject of pressurization, stratification, and interfacial phenomena was completed. The test vessel and test procedures followed in obtaining subcooled nucleate boiling data of liquid nitrogen under fractional gravity and free fall conditions are described. Data are presented in the film boiling region from a disc with a vertical orientation, horizontal facing downward, and horizontal facing upward. The effects of pressure, subcooling, gravity, and orientation are noted. Modifications to the test facility for use with liquid hydrogen are described. A power series solution is obtained for the temperature field in the field in which a spherical bubble is growing as a result of a step change in the boundary movement and/or translatory velocity of the bubble. Bubble growth rates are obtained for the quasi-steady small acceleration and large acceleration cases. The two-dimensional laminar transient free convection heat and mass transfer in cylindrical containers is analyzed using a numerical method

which is briefly described. Results obtained for the flow patterns at two different time levels are given. R.N.A

N66-33184*# Maryland Univ., College Park. Inst. for Molecular Physics.

HEAT CONDUCTIVITY OF POLYATOMIC AND POLAR GASES AND GAS MIXTURES

L. Monchick, A. N. G. Pereira, and E. A. Mason 15 Dec. 1964 60 p refs Submitted for Publication

(Grant NsG-5-59)

(NASA-CR-59973; IMP-NASA-45) CFSTI: HC $3.00/MF $0.75 CSCL 20M

A theory is presented for calculating the heat conductivity of polyatomic and polar gases and gas mixtures. For pure gases, the results are based on the Wang Chang–Uhlenbeck equations and involve no approximations, provided that a suitable definition of an internal diffusion coefficient is employed. This is compared with the known results for a gas of rough spheres, and found to hold to all orders of approximation. Approximations enter for real gases only in obtaining numerical estimates of internal diffusion coefficients and relaxation times. The result is essentially the same as that of Mason and Monchick. For mixtures, the results are based on the formal kinetic theory recently obtained by Monchick, Yun, and Mason. A brief digression on sound absorption and dispersion in mixtures is made in order to identify the cross relaxation times in the formulas. Comparison with experimental results for different mixtures showed that the calculated results were rather insensitive to inelastic collision corrections, provided they were forced to go through the correct end points. It was concluded that for most purposes a theory neglecting inelastic effects in the mixture would be adequate, but that inelastic effects must be included in calculations for the pure components. Author

N66-33231# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

APPROXIMATE ANALYTICAL METHODS IN THE THEORY OF RADIATIVE HEAT TRANSFER IN AN ABSORBING MEDIUM

Yu. A. Surinov 20 Jan. 1966 15 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Fiz. (Tomsk), no. 3, 1960 p 19–26

(FTD-TT-65-1467/1+4; AD-633537) CFSTI: HC $1.00/MF $0.50

This article is concerned with the solution of the problem of radiative heat transfer in a radiating system consisting of a finite number n of uniform and isothermal gray bodies located on the boundary of the system and separated by an absorbing medium consisting of a finite number m of uniform, partially transparent, constant temperature regions (zones). This solution, representing the conclusion of a solving system of algebraic equations for the generized solving scope of radiation, is the basis for the development of a zonal method to calculate radiative heat transfer in different radiating systems and, in particular, in fire boxes and industrial flame furnaces, and also for a theoretical basis for experimental methods of investigating the processes of radiative heat transfer, connected with the application of both thermal and light modeling of the stated processes. Author (TAB)

N66-33233# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CALCULATING THE THERMODYNAMIC FUNCTIONS OF GASEOUS URANIUM, PLUTONIUM AND THEIR IONS UP TO 20,000°K

L. V. Gurvich and V. S. Yugman 20 Jan. 1966 14 p refs Transl. into ENGLISH from Simp. po Thermodinamike Osobym Uporom Na Yadernyye Materialy i Perenos Atomov v Tverdykh Telakh, Vienna, 22–27 Jul. 1965 12 p

(FTD-TT-65-1480/1+2+4; AD-633665) CFSTI: HC $1.00/MF $0.50

Translation of Russian research: calculating the thermodynamic functions of gaseous uranium, plutonium and their ions up to 20,000°K. TAB

N66-33282# Air Force Systems Command, Wright-Patterson AFB, Ohio. AF Flight Dynamics Lab.

FUNDAMENTAL RELATIONSHIPS FOR ABLATION AND HYPERTHERMAL HEAT TRANSFER Final Report

Robert T. Achard Apr. 1966 54 p refs

(AFFDL-TR-66-25; AD-633677) CFSTI: HC $3.00/MF $0.50

A qualitative review of fundamental relationships involved in ablation engineering and aerodynamic heating is presented. This document is written for rapid reading with the primary purpose of introducing the technical area to engineers, scientists, and management personnel associated with but not intimately working in hypervelocity thermal protection. Author (TAB)

N66-33299# Army Cold Regions Research and Engineering Lab., Hanover, N. H.

AN ANALYTICAL INVESTIGATION OF A MODIFIED STEFAN PROBLEM

Yin-Chao Yen and Chi Tien Mar. 1966 22 p refs

(CRREL-RR-185; AD-633489) CFSTI: HC $1.00/MF $0.50

Approximate solutions of temperature distribution and melting rate of ice were obtained for the case where the mode of heat transfer is natural convection due to the thermal instability caused by the heated lower surface. Extensive numerical solutions were obtained for the ice-water system corresponding to various thermal conditions in terms of parameters defined as $R_{\Delta T}=(T_s-T_m)/T_m-T_o$ and $\phi=L/c_p(T_m-T_o)$, where T_s is the temperature of the heat source, T_m is melting point of ice, T_o is the initial temperature of ice, L is the latent heat of fusion, and C_p is heat capacity of ice. Author (TAB)

N66-33303# Army Missile Command, Huntsville, Ala. Translation Branch.

HEAT TRANSFER TO LIQUIDS BOILING IN PIPES AND DURING BULK BOILING

I. T. Aladiev Mar. 1966 16 p refs Transl. into ENGLISH from Teploenerg. (Moscow), v. 10, 1963 p 57–61

(RSIC-530; AD-633583) CFSTI: HC $1.00/MF $0.50

Proposed is a dimensionless equation for the calculation of heat transfer during effervescent boiling of subcooled water and water-steam mixtures in pipes; and bulk boiling of water, ethyl and methyl alcohol, benzene, n-pentane, n-heptane, propane, and carbon tetrachloride. Author (TAB)

N66-33307*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

PRELIMINARY EVALUATION OF A NUMBER OF ABLATIVE HEAT-SHIELD MATERIALS EXPOSED TO COMBINED RADIATIVE AND CONVECTIVE HEATING

Robert R. Dickey and Jack F. Haacker Washington, NASA, Mar. 1963 72 p refs

(NASA-TM-X-784) CFSTI: HC $3.00/MF $0.75 CSCL 20M (Declassified)

Forty-six ablative heat shield materials were tested at combined radiative and convective heat fluxes representative of the maximum stagnation point heat fluxes expected for a manned lifting-type vehicle entering the earth's atmosphere at escape velocity. These tests were made to determine which

materials would be the most promising for more detailed studies to provide specific design data. Data obtained during the tests included time histories of the temperature at the back surface of each material, measurements of the amount of material ablated, and photographs of the ablated surface. The materials were evaluated on the basis of the maximum temperature rise measured at the back surface of a sample of given weight per unit area (4.7 pounds per square foot). Balsa wood and cork had the lowest back-surface temperature rise; and insulating plaster, oak wood, and a group of plastic materials had the next lowest. Approximately half the materials tested appeared to be unsuitable for heat shields at the imposed heating rates because of their relatively high back-surface temperature rise. Author

N66-33308*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

NOTE ON A CORRELATION OF BOUNDARY-LAYER TRANSITION RESULTS ON HIGHLY COOLED BLUNT BODIES

Richard J. Wisniewski Washington, NASA, Dec. 1958 24 p refs

(NASA-MEMO-10-8-58E) CFSTI: HC $1.00/MF $0.50 CSCL 20M (Declassified)

Boundary layer transition data on two types of highly cooled blunt bodies are correlated in terms of ratio of wall to total enthalpy, Reynolds number based on displacement thickness, and local Mach number at transition. The proposed correlation indicates that cooling may cause the boundary layer to go from laminar to turbulent flow even if the surface is smooth within practical limits. Furthermore, an effect of roughness on transition on blunt bodies is also noted. Author

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N66-33310*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

BOUNDARY-LAYER-TRANSITION AND HEAT-TRANSFER MEASUREMENTS FROM FLIGHT TESTS OF BLUNT AND SHARP 50° CONES AT MACH NUMBERS FROM 1.7 TO 4.7

Leo T. Chauvin and Katherine C. Speegle Washington, NACA, 18 Apr. 1957 43 p refs

(NACA-RM-L57D04) CFSTI: HC $2.00/MF $0.50 CSCL 01A (Declassified)

The test Mach number range was from 1.7 to 4.7, corresponding to free stream Reynolds numbers, based on cone base diameter, of 18.3×10^6 and 32.1×10^6, respectively. Transition on both models occurred at a local Reynolds number of 1×10^6 to 2×10^6 based on distance from the stagnation point. Transition Reynolds numbers based on momentum thickness were between 320 and 380 for the blunt cone. The model surface roughness was 25 rms microinches or greater. Turbulent heat transfer to the conical surface of the blunt cone at a Mach number of 4 was 30 percent less than that to the surface of the sharp cone. Available theories predicted heat transfer coefficients reasonably well for the fully laminar or turbulent flow conditions. Author

N66-33322*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

CONVECTIVE HEAT TRANSFER TO A LIFTING FLAT-FACED-CONE ENTRY BOY

James E. Terry Washington, NASA, May 1961 45 p refs

(NASA-TM-X-509) CFSTI: HC $2.00/MF $0.50 CSCL 20M (Declassified)

Heat transfer and pressure distributions were measured at nominal Mach numbers of 4 and 5 and free stream Reynolds numbers varied from 0.50 million to 0.88 million based on base height. Angles of attack varied from −20° to +15°, and angles of sideslip varied from 0° to 15°. The heat transfer distribution was in reasonably good agreement with a Falkner-Skan flow solution based on a measured pressure distribution. Excellent agreement was obtained between theory and experiment for total heat input (exclusive of base heating). Minimum total heat input occurred at an angle of attack of zero with the corresponding lift–drag ratio of about 0.45. Exploratory flow visualization studies were made at a Mach number of 3 in an attempt to find the cause of certain anomalies in the measured heat transfer distributions. Author

N66-33334*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

HEAT-TRANSFER AND PRESSURE DISTRIBUTIONS ON A FLAT-FACE ROUNDED-CORNER BODY OF REVOLUTION WITH AND WITHOUT A FLAP AT A MACH NUMBER OF 8

Robert A. Jones Washington, NASA, Sep. 1962 59 p refs

(NASA-TM-X-703) CFSTI: HC $2.50/MF $0.75 CSCL 20M (Declassified)

Heat-transfer and pressure distributions on a flat-face body of revolution with and without flap control were obtained at a Mach number of 8 and angles of attack from 0° to 45°. This body had a rounded corner, with a ratio of corner radius to body radius of 0.2, and an afterbody angle of 15°. The flap was located at the tangent line of the corner and afterbody. Reynolds numbers based on maximum body diameter were 0.22×10^6 and 0.93×10^6. Author

N66-33335*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

INVESTIGATION OF LITHIUM HYDRIDE AND MAGNESIUM AS HIGH-TEMPERATURE INTERNAL COOLANTS WITH SEVERAL SKIN MATERIALS

Jerry L. Modisette Washington, NACA, 28 May 1958 20 p refs

(NACA-RM-L58B17) CFSTI: HC $1.00/MF $0.50 CSCL 20M (Declassified)

Hemispherical nose shapes of titanium, stainless steel coated with aluminum oxide, and uncoated stainless steel were investigated. The models were tested in the ceramic-heated jet (laboratory model) at a Mach number of 2, a stagnation temperature of 4,000°F, and a stagnation pressure of 105 lb/sq in. abs. A marked cooling effect was noted for lithium hydride with all models tested. A slight cooling effect was noted for the models cooled with magnesium. Author

N66-33408*# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.

THERMAL CONTACT CONDUCTANCE IN A VACUUM ENVIRONMENT

M. F. Bloom 13 Dec. 1964 111 p refs

(Contract NAS7-101)

(NASA-CR-75148; SM-47700) CFSTI: HC $4.00/MF $0.75 CSCL 30M

An apparatus was designed and constructed which produced values of thermal contact conductance in a vacuum environment at low temperatures. The materials tested were aluminum 7075-T6 and stainless steel 17-4 PH. The temperature rang studied was −250° F to +90° F for aluminum and −200° F to +150°F for stainless steel. The vacuum environment was between 10^{-5} and 10^{-6} torr. Thermal contract conductance was obtained as a function of contact pressure, surface roughness and surface flatness deviation. The contract pressure ranged from 0 to 1000 psi. Data in the literature and the present contact conductance data were plotted against contact pressure for various roughnesses on log-log graphs. The power dependence of contact conductance as a function of contact pressure was determined. Low temperature data dependencies were compared to high temperature data dependencies. High temperature literature data and the present low temperature

data were compared to Clausing and Chao's theoretical predictions of thermal contact conductance. Discrepancies between data and theoretical predictions are discussed. Author

N66-33423*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

THE VAPOR PRESSURE OF MAGNESIUM BETWEEN 223° AND 385°C

William P. Gilbreathe [1964] 14 p refs Submitted for Publication

(NASA-TM-X-54897) CFSTI: HC $1.00/MF $0.50 CSCL 20M

The vapor pressure of magnesium between 223° C and 385° C was experimentally determined by Langmuir's method to show that this evaporation technique from a free surface yeilds reliable data down to 223° C (2×10^{-7} torr). A plot of the data obtained from four specimens is given. The experimental procedure consists of monitoring the rate of weight change, as a function of sample temperature, of a magnesium specimen suspended in a high vacuum by an Ainsworth semi-micro vacuum recording balance. The heat source is a collimated light beam from an exterior lamp. It was shown that the method was capable of sensitivity several magnitudes greater than Knudsen's effusion method; however since certain factors affecting the sublimation coefficient are usually more troublesome in Langmuir's method than in Knudsen's, the latter method is generally used with its sensitivity being extended through the use of radio tracers. L.S.

N66-33552# Argonne National Lab., Ill.

AN INVESTIGATION OF LIQUID-METAL HEAT TRANSFER IN A COCURRENT-FLOW, DOUBLE-PIPE, HEAT EXCHANGER

Richard L. Merriam Jun. 1965 120 p refs

(Contract W-31-109-ENG-38)

(ANL-7056) CFSTI: $4.00

The analysis predicts local and fully developed heat-transfer coefficients, as well as overall rates of heat transfer. It is shown that: (1) heat-transfer coefficients depend upon the operating conditions of the heat exchanger, and their values can be significantly lower than those corresponding to a uniform surface temperature boundary condition, (2) use of the customary design equation to predict heat exchanger performance can lead to significant errors. The construction of a mercury heat-transfer loop and experiments with cocurrent flow, double pipe, heat-exchanger, test sections is described, including application of a new experimental technique to obtain values of fully-developed heat-transfer coefficients. The experimental results showed agreement with the analysis. Author

N66-33657# ARO, Inc., Arnold Air Force Station, Tenn.

A FILM COOLING EXPERIMENT ON A CONVERGENT-DIVERGENT NOZZLE

Henry F. Lewis and Dennis D. Horn Arnold Eng. Develop. Center, Jun. 1966 32 p refs

(Contract AF 40(600)-1200)

(AEDC-TR-66-78; AD-634587) CFSTI: HC $2.00/MF $0.50

A stainless steel, supersonic nozzle with an 11/16-in. diam. throat was successfully cooled using only a tangential air film. Mass fractions of cooling air film ranged from 0.190 to 0.302, and the maximum recorded wall temperature was 1800° F. Stilling chamber pressures ranged from 482 to 577 psia and temperatures from 2615° to 3460° F. Measured wall temperatures showed only limited agreement with a newly developed theory, with the theory underestimating adiabatic wall temperatures by from 20 to 30 percent. Author (TAB)

N66-33663# Tennessee Univ., Knoxville. Dept. of Nuclear Engineering.

FILM AND TRANSPIRATION COOLING OF NOZZLE THROATS

H. C. Roland, P. F. Pasqua, and P. N. Stevens Arnold Air Force Station, Tenn., Arnold Eng. Develop. Center, Jun. 1966 158 p refs

(Contract AF 40(600)-981)

(AEDC-TR-66-88; AD-634588) CFSTI: HC $5.00/MF $1.00

The following conclusions were drawn: (1) gas film cooling can be used to measurably lower the wall temperatures and the wall heat fluxes in the converging section and at the throat of a high pressure, high temperature nozzle. Some gross mixing occurs at the injection point. The exact amount being some as yet undetermined function of the injection geometry. The relative velocities of the main gas stream and the coolant stream at the injection point, and the entering velocity profiles and turbulence conditions, (2) a straightforward boundary layer type analysis was developed and programmed which predicts with reasonable accuracy the nozzle wall temperatures and wall heat fluxes in the converging section and at the throat for gas film cooled nozzles. (3) calculational techniques were developed and programmed for predicting the effectiveness of liquid film cooling and liquid or gas transpiration cooling in nozzles. These techniques should be checked against experimental data before they are used for design purposes, however. Author (TAB)

N66-33667*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

COMBUSTION

Richard S. Brokaw, Frank E. Belles, Bruce J. Clark, and Frank J. Zeleznik *In its* Selected Technol. for the Petrol. Ind. 1966 p 5-23 refs (See N66-33666 19-34) GPO: HC $1.25; CFSTI: MF $0.50

The basic concepts and processes of combustion systems in rocket and ramjet engines are reviewed. The large number of equations to be solved for each chemical system, and computer programs for solving them are emphasized. Transport properties, needed to calculate heat transfer pertinent to cooling and in connection with the vaporization of liquid propellants, are discussed. Atomization of liquid propellant is described, and drop size distribution data are mentioned. The complexity of calculating the rate at which drops of known size vaporize is summarized. Characteristics of ignition reaction are presented. Chemical reaction rates, and their effects on nozzle flows and heat conduction are discussed. N.E.N.

N66-33688*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SOME DEVELOPMENTS IN AEROSPACE HEAT TRANSFER

Robert Siegel, Robert W. Graham, Vernon M. Gray, John R. Howell, and William L. Jones *In its* Selected Technol. for the Petrol. Ind. 1966 p 25-43 refs (See N66-33666 19-34) GPO: HC $1.25; CFSTI: MF $0.50

Heat transfer problems connected with nuclear rocket engines and space electric power generation systems are discussed. The problem areas in the nuclear rocket engine are reported as resulting from the great temperature differences required in the reactor core and in the nozzle. The gas-side heat transfer in the rocket nozzle and heat transfer in the coolant passages of the nozzle are discussed. The space electric power plant components and space boiler are described, along with nucleate and film pool boiling. The difficulties connected with heat transfer in the boiler, boiler instabilities, and the radiator are reviewed. The basic problems are identified as turbulent heat transfer with large flow accelerations, flow of near-critical fluids in curved channels, solidification of a liquid flowing over a cooled surface, and high temperature forced flow boiling. N.E.N.

N66-33677*# National Aeronautics and Space Administration, washington, D. C.
VAPOR PRESSURE IN SOLID YTTRIUM [TISK PARI TVERDOGO ITRYYU]
A. A. Kruglykh, V. S. Pavlov, and G. P. Tikhyns'kiy Jun. 1966 9 p refs Transl. into English from Ukr. Fiz. Zh. (Kiev), v. 9, no. 2, 1964 p 214–215
(NASA-TT-F-10210) CFSTI: HC $1.00/MF $0.50 CSCL 20M

The vapor pressure of yttrium was determined over the temperature range of 1100° to 1480° C by evaporation from a cylindrical crucible. The results are expressed by the equation

$$\log P_{mm} = -\frac{18500}{T} + 7.580$$

Author

N66-33678*# National Aeronautics and Space Administration, Washington, D. C.
INVESTIGATION OF WALL SURFACE TEMPERATURE BEHIND A MOVING SHOCK WAVE [ISSLEDOVANIYE TEMPERATURY POVERKHNOSTI STENKI ZA DVIZHUSHCHEYSYA UDARNOY VOLNOY]
M. V. Volodina, Yu. A. Dem'yanov, S. S. Kellin, and N. V. Chereshneva Jun. 1966 11 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 6, 1960 p 112–116
(NASA-TT-F-10219) CFSTI: HC $1.00/MF $0.50 CSCL 20M

The wall surface temperature behind a moving shock nonstationary boundary layer equations are solved for a plate, for constant flux behind the shock wave. Experiment and theory agree to within the experimental accuracy (±10–15%). Author

N66-33679*# National Aeronautics and Space Administration, Washington, D. C.
DETERMINATION OF THE SATURATED VAPOR PRESSURE OF NIOBIUM DIOXIDE [OPREDELENIYE DAVLENIYA NASYSCHENNOGO PARA DVUOKISI NIOBIYA]
S. A. Shchukarev, G. A. Semenov, and K. Ye. Frantseva Jun. 1966 11 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 145, no. 1, 1962 p 119–121
(NASA-TT-F-10220) CFSTI: HC $1.00/MF $0.50 CSCL 20M

The vapor pressure of niobium dioxide is determined using the Knudsen effusion method. The cylindrical effusion chamber and the associated apparatus are described. The computed dissociation energy of NbO_2 is 14.9±.1 volts. Author

N66-33689*# National Aeronautics and Space Administration, Washington, D. C.
FEATURES OF FILM BOILING IN SURFACE WATER COOLING [OSOBENNOSTI PLENOCHNOGO KIPENIYA PRI POVERKHNOSTNOM VODYANOM OKHLAZHDENII]
A. D. Akimenko Jun. 1966 9 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (USSR), v. 7, no. 6, 1964 p 32–34
(NASA-TT-F-10184) CFSTI: HC $1.00/MF $0.50 CSCL 20M

The results of investigating the heat transfer during the cooling of heated surfaces by water jets or with the aid of injectors are discussed. A study is also made as to the dependence of the second critical load during film boiling on the specific water discharge and a number of other factors. Author

N66-33693*# National Aeronautics and Space Administration, Washington, D. C.
HEAT TRANSFER IN THE NEIGHBORHOOD OF THE BLUNT LEADING EDGE OF A CYLINDRICAL WING DURING SLIP [TEPLOOBMEN V OKRESTNOSTI TUPOY PEREDNEY KROMKI TSILINDRICHESKOGO KRYLA PRI SKOL'ZHENII]
A. A. Yarkho Jun. 1966 14 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zaved., Ser. Aviats. Tekh. (Kazan), no. 3, 1960 p 22–27
(NASA-TT-F-10218) CFSTI: HC $1.00/MF $0.50 CSCL 01A

The work applies the two-dimensional solution of the heat transfer problem to a three-dimensional case with gas flow under stationary conditions and constant laminar flow, Prandtl number, specific heat and wing surface temperature. Author

N66-33695*# National Aeronautics and Space Administration, Washington, D. C.
DETERMINATION OF THE THERMAL CHARACTERISTICS OF A TWO-DIMENSIONAL LAMINAR BOUNDARY LAYER IN A COMPRESSIBLE GAS WITHOUT A LONGITUDINAL PRESSURE GRADIENT, IN THE VICINITY OF THE FORWARD STAGNATION POINT [OB OPREDELENII TEPLOVYKH KHARAKTERISTIK DVUKHMERNOGO LAMINARNOGO POGRANICHNOGO SLOYA V SZHIMAYEMOM GAZE PRI OTSUTSTVII PRODOL'NOGO GRADIYENTA DAVLENIYA I V OKRESTNOSTI PEREDNEY KRITICHESKOY TOCHKI]
I. I. Suksov Jun. 1966 21 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zaved., Ser. Aviats. Tekhn. (Kazan), no. 1, 1961 p 27–37
(NASA-TT-F-10217) CFSTI: HC $1.00/MF $0.50 CSCL 20M

Simple approximate solutions in finite form are derived for the determination of friction, recovery, and heat transfer coefficients for a plane plate in the vicinity of the forward stagnation point, applicable to the cases of high aerodynamic heating in the two-dimensional boundary layer of a compressible gas without pressure gradient. The solutions are extended to the boundary layers of bodies of revolution, over the Stepanov–Mangler transformation. Author

N66-33702*# National Aeronautics and Space Administration, Washington, D. C.
RADIATIVE HEAT TRANSFER NEAR THE STAGNATION POINT OF A BLUNT BODY [LUCHISTYY TEPLOOBMEN V OKRESTNOSTI LOBOVOY TOCHKI TUPOGO TELA]
Z. S. Galanova May 1966 20 p refs Transl. into ENGLISH from Vestn. Leningr. Univ., Ser. Mat., Mekh. i Astron. (Leningrad), no. 1, Issue 1, 1966 p 120–130
(NASA-TT-F-10087) CFSTI: HC $1.00/MF $0.50 CSCL 20M

Two problems of calculating radiative heat transfer near the stagnation point of a two-dimensional or axisymmetric body in hypersonic flow are considered: the effect of radiative heat transfer on convective heat transfer and calculation of the radiant heat flux from a certain volume of gas toward a given point on the body. Equations are obtained that determine the heat flux toward the wall due to the heat conductivity of the gas and to radiation using the hypothesis of a two-dimensional parallel layer which replaces the region between the shock wave and body and whose width equals the shock layer. The problem of calculating the radiant heat flux toward a certain region near the stagnation point of a sphere is analyzed without using the hypothesis of a two-dimensional parallel layer. Formulas for computing the mutual effects of radiative heat transfer and heat conductivity, and for radiant heat flow to the neighborhood of the stagnation point are obtained. Author

N66-33710*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL INVESTIGATION OF BAFFLE EFFECTIVENESS IN A CONFINED FLUID SUBJECTED TO WALL AND NONUNIFORM SOURCE HEATING
Thomas John Biesiadny (M.S. Thesis—Purdue Univ.) Aug. 1966 66 p refs
(NASA-TM-X-57817) CFSTI: HC $3.00/MF $0.75 CSCL 21I

Heating of liquid hydrogen in the propellant tank of a nuclear rocket was simulated in a two dimensional view tank with and without baffles present. The effectiveness of the baffles in preventing the occurrence of large fluid temperature differences was determined. To accomplish this objective a mixture of trichloroethane and ethyl alcohol was used to represent the liquid hydrogen. Both wall and nonuniform source heating occur in nuclear rocket propellant tanks. In this study infrared rays from quartz lamps were used to produce the two types of heating required. The tanks were subjected to similar heating conditions with and without baffles, and visual information concerning fluid behavior was obtained using schlieren photographs. Fluid temperatures were measured using thermocouples. Quantitative comparisons were made possible by calculating a temperature nonuniformity parameter for each case. Author

N66-33767*# National Aeronautics and Space Administration, Washington, D. C.
ENHANCEMENT OF CONVECTIVE HEAT TRANSFER IN CHANNELS BY MEANS OF ARTIFICIAL FLOW TURBULENCE [OB INTENSIFIKATSII KONVEKTIVNOGO TEPLOOBMENA V KANALAKH PUTEM PRIMENENIYA ISKUSSTVENNOY TURBULIZATSII POTOKA]
V. K. Migai Aug. 1966 26 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Energ. i Transport (Moscow), no. 6, 1966 p 123–131
(NASA-TT-F-10257) CFSTI: HC $2.00/MF $0.50 CSCL 20M

Evaluation of the enhancement of convective heat transfer by turbulent flows through profile, roughened, and corrugated (finned) channels. The evaluation is based on an analysis of the structure of a two-layer turbulent flow. An equation containing three empirical constants is derived to characterize the limiting turbulence of a flow composed of a layer with a constant coefficient of turbulent heat exchange and a viscous sublayer in which the molecular viscosity is greater than its turbulent viscosity. Artificial roughness is found to increase heat removal in channels by a factor of 1.5. The reduction of heat exchanger dimensions by diminishing the exchanger diameter, by increasing heat carrier velocity, or through a wider use of finned surface is suggested. Author

N66-33809# Southern Forest Fire Lab., Macon, Ga.
PROJECT FIRE MODEL: AN EXPERIMENTAL STUDY OF MODEL FIRES Final Report
G. M. Byram, H. B. Clements, M. E. Bishop, and R. M. Nelson, Jr. 1 Jun. 1966 48 p refs
(Contract OCD-PS-65-40)
(AD-633709) CFSTI: HC $2.00/MF $0.50

The main objectives of the experimental work described in the report were (1) to gain more knowledge of the structure of freeburning fires, (2) to obtain a better understanding of the mechanisms of fire spread, and (3) to determine the significance of some of the many independent variables in fire spread. Although it was not possible to predict the behavior of large-scale fires from the crib and pool fires used in this study, the information gained from these tests was essential for work now underway in the development of scaling laws and in determining the characteristics that a model fire should have. The report deals primarily with the physical characteristics such as rate of spread, fuel burning rate, flame length, flame temperature, and flame velocity of crib and pool fires. It also considers the possible effect of wind speed and slope on the residence time and the unit area burning rate—two basic fuel bed parameters. Some results of work now in progress on scaling law development is summarized briefly. Author (TAB)

N66-33823# General Applied Science Labs., Inc., Westbury, N. Y.
SUPERSONIC COMBUSTION IN PREMIXED HYDROCARBON–AIR FLOW Final Report
J. Tamagno, I. Fruchtman, and S. Slutsky May 1966 64 p refs
(Contract AF 49(638)-1503)
(TR-602; AFOSR-66-0872; AD-633977) CFSTI: HC $3.00/MF $0.75

A study of the mechanisms of ignition and flame propagation of supersonic air–hydrogen fuel mixtures at temperatures below the published autoignition limits was made. The hydrocarbons considered were: methane CH_4, ethane C_2H_6, ethylene C_2H_4 and propane C_3H_8 with flame ignition and stabilization by means of a small hydrogen–oxygen pilot flame. Flame speeds for methane, ethane, and ethylene–air mixtures were found to be; four, three and two times smaller, respectively than hydrogen–air flame speeds under similar flow conditions. The dependence of the flame speed on the initial mixture temperature was correlated by a simple exponential relation. Addition of a small amount of hydrogen to a methane–air mixture resulted in doubling the observed flame angle. Finally, measurement of flame temperature distribution and spreading rate were shown to be in agreement with results of a theoretical analysis incorporating finite rate methane–air chemistry and axisymmetric diffusive flow. Author (TAB)

N66-33839# Naval Avionics Facility, Indianapolis, Ind.
RESULTS OF HEAT TRANSFER STUDIES PERFORMED ON NAFI STANDARD HARDWARE STYLE 1-A, TYPE 3 MODULES
Mickey Owen 10 May 1966 53 p refs
(NAFI-TR-781; AD-634088) CFSTI: HC $3.00/MF $0.50

The report investigates the relationships between the actual operating temperatures of NAFI standard hardware type 3 modules and the theoretical operating temperatures. The theoretical operating temperatures were calculated from standard heat transfer methods. The results point out that the actual and theoretical operating temperatures are sufficiently close that calculated temperatures may be used for preliminary design purposes without introducing significant errors. Author (TAB)

N66-33857# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE STRUCTURE OF A DETONATION FRONT IN GASSES
B. V. Voytsekhovskiy, V. V. Mitrofanov, and M. Ye. Topchiyan 9 Feb. 1966 183 p refs Transl. into ENGLISH from the book "Struktura Fronta Detonatsii v Gazakh" Novosibirsk, Izd. AN SSSR, 1963 p 1–168
(FTD-MT-64-527; TT-66-61423; AD-633821) CFSTI: HC $5.00/MF $1.00

The purpose of the report is to present results of investigations of the structure of transverse perturbations of the actual detonation front in gases. TAB

N66-33870# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.
TRANSITION BOILING HEAT TRANSFER PROGRAM Quarterly Progress Report No. 13, Jan.–Mar. 1966

1 Apr. 1966 18 p
(Contract AT(04-3)-189)
(GEAP-5146; EURAEC-1627) CFSTI: HC $1.00/MF $0.50

Conceptual design of test equipment and instrumentation to measure heat transfer coefficients and steam phase superheat levels was started. Preliminary analysis of heat transfer from steam to droplets is presented, which can explain the very large evaporative heat transfer coefficients that have been inferred from experiments. Author (NSA)

N66-33896# IIT Research Inst., Chicago, Ill.
DETERMINATION OF PHYSICAL-CHEMICAL CHARACTERISTICS OF METAL-METAL OXIDE MIXTURES Final Report 6 Apr.-5 Jul. 1965
James L. Austing and James E. Kennedy 26 Jan. 1966 205 p refs Prepared for Sandia Corp.
(Contract AT(29-1)-789)
(SC-CR-66-2019) CFSTI: HC $6.00/MF $1.25

A combined experimental and theoretical study on the ignition of metal-metal oxide mixtures in contact with electrically pulsed bridgewires was performed. The systems that were studied included aluminum-tungstic oxide, aluminum-copper oxide, aluminum-vanadium pentoxide, and aluminum-molybdic oxide. The thermal conductivity of metal-metal oxide pellets pressed at 5000 psi in air was measured, and values of approximately 1×10^{-3} cal/sec cm^2°C were obtained. Variation in the percentage of aluminum in the mixture had an observable effect on thermal conductivity. Constant current ignition tests were conducted over a range of 7 to 50 amperes, using a low-inductance firing circuit that had a rise time of 10 μsec. The metal-metal oxide powder was pressed into initiators containing Kovar-glass headers bridged with 5-mil Evanohm wire. Resistance during firing and overall function time of the initiator were monitored. The time of ignition of the metal-metal oxide was clearly evident on the records. Excellent correlation of burning rate with density was obtained for the Al-WO_3 systems. For most systems, an increase in density caused slower burning of the column. An increase in aluminum content caused more rapid burning. The manner in which the bridgewire was welded to the prongs of the Kover-glass header was studied. Headers on which the bridgewire was welded in a cross-eyed manner caused a noticeable decrease in ignition time variation, as compared to that for headers in which the bridgewire weld position was not controlled. The heat loss factor of the Rosenthal electro-thermal equation was determined for initiators loaded with pressed metal-metal oxide. Values of heat loss factor were in the range 0.0050 to 0.0270 watts/°C, but did not correlate with metal-metal oxide density. Comparison of the experimentally observed ignition times with calculated bridgewire temperature histories for selected heat loss factor values showed that ignition occurred sometime after bridegwire melting. NSA

N66-33925# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
HEAT TRANSFER ON THE SURFACE OF A SPHERE IN THE FIXED BED [WYMIANA CIEPLA NA POWIERZCHNI KULI W ZLOZU Z KUL]
A. Wierusz Sep. 1965 116 p refs In POLISH
(INR-658/IX/R)

The local processes in a gas cooled spheres bed are described. The thermal boundary layer equation valid for a region of spheres surface where the laminar boundary layer exists, is presented. The numerical solution of this equation is possible thanks to experimental measurements of the velocity field around a sphere in the bed. The solution is used for the determination of the local values of Nusselt numbers. Author (NSA)

N66-33938# Columbia Univ., New York. Dept. of Chemical Engineering.
HIGH TEMPERATURE THERMAL PROPERTIES OF GASES AND VAPORS DURING THE YEAR 1965/66 Progress Report
Charles F. Bonilla Feb. 1966 14 p refs
(Contract AT(30-1)-2660)
(CU-2660-26) CFSTI: HC $1.00/MF $0.50

The principal new final experimental results obtained during the last year include data on the viscosity of cesium vapor at atmospheric pressure, and on the surface tension of potassium at high temperatures. The principal theoretical result is the calculation of errors in long sheathed thermocouples at high temperatures due to leakage currents among the thermocouple wires and the sheath, and the resulting IR drops along the wires. Results of studies on thermal conductivity of alkali metal vapors, high-temperature vapor pressure and critical point of alkali metals, near-critical saturated liquid and vapor phase densities and the critical point of alkali metals, and high-temperature thermodynamics of the K-Hg system are also reported. NSA

N66-33946# Los Alamos Scientific Lab., N. Mex.
THERMODYNAMICS OF INTERSTITIAL PHASES AND DEFECT COMPOUNDS
Gerald L. De Poorter 20 Jan. 1966 21 p refs
(Contract W-7405-ENG-36)
(LA-3481) CFSTI: HC $1.00/MF $0.50

Known thermodynamic properties were used to determine the validity of theoretical models for calculating thermodynamic properties of interstitial solid solutions and defect compounds. The model for interstitial solid solutions is shown to be unacceptable for several reasons and the model for defect compounds does not satisfy the assumptions on which it is based. Author (NSA)

N66-34017# North American Aviation, Inc., Columbus, Ohio.
AERODYNAMIC HEATING IN THE VICINITY OF SURFACE PROTUBERANCES Final Report
Michael C. Fong 30 Mar. 1966 136 p refs
(Contract NOw-61-0719-t)
(NA65H-891; AD-633762) CFSTI: HC $4.00/MF $1.00

An analytical method based on the two-parameter momentum-integral concept has been developed for laminar supersonic flows over a two-dimensional protuberance. This method is applicable both to the case where the external pressure field is prescribed and to the 'free interaction' problem for which the mathematical solution for the local flow disturbance is not directly influenced by the downstream geometry of the disturbance source. By comparing with experimentally determined pressure and heat transfer data for a wide range of separated flow problems, it has been found that the theory is valid in regions up to and beyond the separation point. The analytical procedures can also be applied to separated flows on the plane of symmetry upstream of a cylindrical protuberance and over an unyawed axisymmetric body. An experimental program utilizing the DTMB hypersonic tunnel facility has been prepared for measuring surface pressure and heat transfer rates in the vicinity of cylindrical protuberances. Protuberance model design and fabrication, as well as preliminary tunnel check-outs have been completed. Development of semi-empirical procedures for predicting protuberance-induced heating effects and verification of the two-parameter analytical theory may be undertaken when quantitative test data are available. Author (TAB)

N66-34023# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

TEMPERATURE PROFILES IN BODIES TRAVELING AT HIGH ALTITUDES AT HYPERSONIC SPEED

I. N. Murzinov 20 Jan. 1966 9 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekh. Nauk: Mekhan. i Mashinostr. (Moscow), no. 4, 1964 p 148–150

(FTD-TT-65-1478/1+2+4; AD-633713) CFSTI: HC $1.00/MF $0.50

Solutions were obtained for temperature profiles in semi-bounded rods thermally isolated from one end with constant thermophysical characteristics with heat-transfer laws typical for bodies traveling in the atmosphere at high supersonic velocities. In the first approximation radiation heat transfer at the end of the rod was neglected; in the second approximation energy radiated by the body was taken into account in the boundary conditions with respect to the results of the first approximation. Evaluations are given of the time for which the obtained approximations were correct. Author

N66-34036# United Kingdom Atomic Energy Authority, Risley (England).

HEAT TRANSFER FROM SURFACES ROUGHENED BY SQUARE RIBS AT PITCH TO HEIGHT RATIOS OF 5, 7.2, 9.4 AND 15

D. Wilkie 8 Mar. 1966 22 p refs

(TRG-1127(W))

Heat transfer and pressure drop data are presented for surfaces roughened by square ribs at pitch to height ratios of 5, 7.2, 9.4 and 15 and height to equivalent diameter ratios from 0.002 to 0.0104 over a Reynolds number range from 0.75×10^5 to 10^6. The tests, which were with air, provide an estimate of the effect on friction factor of wall to bulk coolant temperature ratio. Author

N66-34039# Royal Aircraft Establishment, Farnborough (England).

A NEW METHOD FOR THE MEASUREMENT OF HEAT TRANSFER

P. H. H. Bishop and K. F. Rogers Feb. 1966 30 p refs

(RAE-TR-66040) CFSTI: HC $2.00/MF $0.50

A new method for the determination of heat transfer is proposed, based on the relation: $h = -\Delta P/\Delta T$, where ΔP is the power required to maintain temperature at one point, following a depression in temperature ΔT at another point. The method has been applied to the determination of thermal conductivity of standard silica and ebonite specimens, and gave results correct to within a few per cent. For the general measurement of heat transfer, the method may be used to distinguish between heat flows of particular interest and extraneous flows. Author

N66-34073*# Case Inst. of Tech., Cleveland, Ohio.

ON SOLUTION STRUCTURE OF THE RADIAL HEAT PROBLEM WITH SINGULAR DATA

L. R. Bragg Aug. 1966 25 p refs

(Grant NsG-544)

(NASA-CR-77082) CFSTI: HC $1.00/MF $0.50 CSCL 20M

The structure and behavior of the solutions of an initial value problem for various choices of the data function $\phi(r)$ was investigated. Particular emphasis was given to solutions corresponding to functions $\phi(r)$ that have poles or logarithmic singularities at r=0 but which are otherwise analytic. The basic definitions, notations, and results from previous work are summarized, and a pair of solution forms corresponding to data functions having poles or logarithmic singularities at r=0 is introduced. Relations among solutions and properties of these solutions are developed when $\phi(r)$ is entire or has poles but no logarithmic singularities. Solutions corresponding to data of the form $\phi(r) = \Psi(r) \log r$, when $\Psi(r)$ is entire in r^2 and secondly when $\Psi(r)$ has a pole are discussed. Elementary examples are provided throughout to illustrate theorems or properties of solutions. N.E.N.

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N66-32699# Library of Congress, Washington, D. C. Aerospace Technology Div.

FOREIGN SCIENCE BULLETIN, VOLUME 2, NUMBER 6

Jun. 1966 92 p refs

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1. THE POSSIBILITY OF LASER ACTION IN A RAPIDLY COOLED, HIGHLY IONIZED PLASMA C. Shishkevish p 1–19 refs (See N66-32700 19-25)

2. POLYTITANOORGANOSILOXANES AND SOME OTHER METAL-CONTAINING POLYMERS B. Nartsissov p 10–18 refs (See N66-32701 19-06)

3. GROWTH AND FERROELECTRIC PROPERTY OF LITHIUM TANTALATE AND LITHIUM NIOBATE SINGLE CRYSTALS J. G. Kourilo p 19–25 refs (See N66-32702 19-26)

4. SOVIET SCIENTIFIC ACHIEVEMENTS DURING 1965 N. M. Sisaskyan p 26–44

5. REVIEW OF MEDICAL RESEARCH CONDUCTED BY THE SOVIET ANTARCTIC EXPEDITION p 44–50 refs

6. CINEMATOGRAPHY IN SOVIET SPACE TECHNOLOGY p 50–53 ref (See N66-32703 19-14)

7. TWENTY-EIGHTH SESSION OF THE COUNCIL ON SEISMOLOGY p 54–61 ref

8. COMPLEX (MULTI-DISCIPLINE) INVESTIGATIONS OF THE EARTH'S CRUST AND THE UPPER MANTLE p 61–64 ref

9. SESSION ON THE INVESTIGATION OF WIND-PRODUCED WAVES AND THEIR EFFECT ON STRUCTURES p 65–67 ref

N66-33074# Advisory Group for Aerospace Research and Development, Paris (France).

GENERAL INFORMATION, 1966

[1966] 29 p

CFSTI: HC $2.00/MF $0.50

Information is provided on the operation and organization of the Advisory Group for Aerospace Research and Development (AGARD), and some examples of the work accomplished by this group of scientists are cited. The mission of AGARD is outlined, the national delegates are identified, and the interests and goals of AGARD's panels and committees are highlighted. H.S.W.

N66-33134# India. Dept. of Atomic Energy, Bombay.

SCIENCE AND THE PROBLEMS OF DEVELOPMENT

H. J. Bhabha 1966 14 p Presented at Intern. Council of Sci. Unions, 7 Jan. 1966

CFSTI: HC $1.00/MF $0.50

Means of establishing science as a national activity in an underdeveloped country such as India are discussed. Universities, government organizations, and national laboratories are cited as domains of scientific activity. Atomic energy research is described as a growing science, and the role of administration required for growth of science and technology is stressed. S.P.

N66-33171*# National Aeronautics and Space Administration, Washington, D. C.
[MANAGEMENT OF SCIENCE]
B. C. Meyers, II [1964] 13 p Presented at the Intern. Management Conf., SAM, N. Y., 16 Oct. 1964
(NASA-TM-X-54868) CFSTI: HC $1.00/MF $0.50 CSCL 05A

This discussion presents a general picture of NASA's concept, philosophy, and general approach to research management. NASA's management provides constructive guidance by beginning with the establishment of technological goals to be achieved in a measurable time period. This automatically leads to the necessity for continuing assessment of the progress toward these goals which provides the basis for the judgements that allow the course toward these long goals to be altered. NASA's management effort is built on a pyramid organization for administrative purposes, but with a flat and direct approach to the scientific and engineering activities. Inherent in the scheme is the fact that 85% of the work is applied research with the other 15% devoted to basic research. NASA's management concept stresses the communication of ideas, theories, and discoveries throughout the scientific and engineering community which includes a program for the publication and exchange of information. It has cooperative programs with foreign countries and supports and sponsors university research, training, and space experiments. Other aspects discussed include the recognition of individual productivity, encouragement of scientists to publish their works, and educational assistance. R.N.A.

N66-33395*# George Washington Univ., Washington, D. C.
THE SOVIET UNION AND THE UNTED STATES IN SPACE. MEMORANDUM ON THE SEMINARS, 23 MARCH–20 APRIL 1965
Carol Horning Stacey Mar. 1966 24 p
(Grant NsG-727)
(NASA-CR-77006) CFSTI: HC $1.00/MF $0.50 CSCL 22A

A review and interpretation of the status of the Soviet space program is made from data gleaned from five seminars attended by government, industry, and academic leaders. A comparison of Soviet and United States programs concludes that the U.S. is ahead in the development of the civilian uses of space, in international cooperation, and in attracting friends among the world's scientific community as well as the physical sciences, tracking, and lunar and planetary exploration. The Soviet Union has the advantage in appeal to the common man, in rocket thrust and payload delivery, in medical and biological science, and in manned flight. While it was agreed that the U. S. has a tremendous advantage in its worldwide tracking system, there was some doubt as to how much the lack of such a system really handicaps the Soviet Union. It is pointed out that Soviet security policy and showmanship make it difficult to evaluate their accomplishments. M.W.R.

N66-33422*# Massachusetts Inst. of Tech., Cambridge Research Lab. of Electronics.
WHAT'S IN THE BRAIN THAT INK MAY CHARACTER?
Warren S. Mc Culloch [1964] 14 p refs Presented at the Intern. Congr. for Logic, Methodology and Phil. of Sci., Jerusalem, 28 Aug. 1964
(Grant NsG-446; Contracts DA-36-039-AMC-03200(E); AF 33(615)-1747; Grants NSF GP-2495; NIH G-MH-04737-04; et al)
(NASA-CR-59932) CFSTI: HC $1.00/MF $0.50 CSCL 05F

The author's reflections are presented concerning the failure of himself and others to derive an adequate mathematical model for neurophysiological processes, in general, and an actual neuron, in particular. It is stated that the problem is one of triadic or n-adic relations, and is almost, or perhaps entirely, unspecifiable in finite and unambiguous terms without the derivation of a multivalued propositional calculus. The final statement of the reasons for failure reads as follows: There is no adequate expression for a triadic logic; it is not known how we create hypotheses which are natural and simple; and there exists no theory accounting for those abductions which have permitted our evolution, ensured our ontogenesis, and preserved our lives. D.T.

N66-33574# Congress. Senate. Committee on Appropriations.
INDEPENDENT OFFICES APPROPRIATIONS FOR FISCAL YEAR 1967, PART 1
Washington, GPO, 1966 1082 p Hearings Before Subcomm. of the Comm. of Appropriations, 89th Congr., 2d Sess. on H. R. 14921, 9–23 May 1966

The text of NASA's testimony in support of the requested appropriation is presented. Accomplishments are reviewed, the status of current programs is detailed, and the objectives of planned space explorations are defined. NASA's relationships with industry and universities are assessed, and administrative operation and personnel requirements are discussed. Data on the budget estimates for the 27 agencies and the one Department covered by the overall bill are tabulated, along with the Senate and House recommendations. M.G.J.

N66-33649# Selwood Research, Inc., Kensington, Md.
TEST MANUAL FOR ENGINEERING WATER TESTS OF HIGH SPEED AMPHIBIOUS VEHICLES Final Report, 21 Jun.–1 Oct. 1965
John L. B. Selwood and Alexander W. Fowler 22 Apr. 1966 126 p refs
(Contract Nonr-5016(00))
(Rept.-104-002; AD-633880) CFSTI: HC $4.00/MF $0.75

The test handbook is concerned with the tests of the LVW, LVH1, LVH2, ARCK, the LVK and their successors all of which can exceed a speed of 25 knots. Author (TAB)

N66-33666*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
SELECTED TECHNOLOGY FOR THE PETROLEUM INDUSTRY
Washington, NASA, 1966 186 p refs Conf. held at Cleveland, 8–9 Dec. 1965
(NASA-SP-5053) GPO: HC $1.25; CFSTI: MF $0.50 CSCL 13H

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8. STORAGE AND HANDLING OF CRYOGENIC FLUIDS D. L. Nored, G. Hennings, D. H. Sinclair, G. T. Smith, G. R. Smolak, and A. J. Stofan p 125–153 (See N66-33674 19-15)

9. TECHNOLOGY UTILIZATION B. M. Kerr, M. S. Day, G. J. Howick, R. L. Lesher, and H. L. Timms (NASA. Washington, D. C.) p 155–166 (See N66-33675 19-34)

N66-33675*# National Aeronautics and Space Administration, Washington, D. C.

TECHNOLOGY UTILIZATION

Breene M. Kerr, Melvin S. Day, George J. Howick, Richard L. Lesher, and Howard L. Timms (Aerospace Res. Appl. Center) *In* NASA. Lewis Res. Center Selected Technol. for the Petrol. Ind. 1966 p 155–166 (See N66-33666 19-34) GPO: HC $1.25; CFSTI: MF $0.50

The two main parts of the NASA Office of Technology Utilization Program are identified as: (1) the Scientific and Technical Information Division, which provides a reservoir of knowledge from domestic and foreign sources, and (2) Technology Utilization Division, which selects from the computer-indexed storehouse those discoveries, ideas, and procedures that appear most promising for adaptation, and provides means of seeking out new ideas. The acquisition, abstracting, and publication of documents is described. The dissemination center activities in matching the technical needs and interests of industrial firms to the information resources is illustrated. N.E.N.

N66-34024 System Development Corp., Santa Monica, Calif.

STOCHASTIC DUELS WITH TIME-OF-FLIGHT INCLUDED

C. J. Ancker, Jr. 19 May 1966 31 p refs Presented at the 29th Natl. Meeting of the Operations Res. Soc. of Am., Santa Monica, Calif., 19 May 1966

(SP-1017/009/00; AD-633912) CFSTI: HC $2.00/MF $0.50

The fundamental duel in the theory of stochastic duels is extended to include projectile time-of-flight. As a preliminary, the marksman firing at a passive target is studied. Two firing procedures are assumed. In one, refiring proceeds as rapidly as possible, whereas in the other the duelist delays until he observes the effect of each round. Both fixed (discrete) and continuous (random) firing-times are considered. Also included is the case where time-of-flight varies uniformly with elapsed time. General solutions and examples are given. The analysis indicates in a quantitative way how time-of-flight may radically influence the outcome. Author (TAB)

N66-34037# Bundesministerium für Verkehr, Bonn (West Germany).

STATUS AND SPECIAL PROBLEMS OF THE GERMAN CIVIL AVIATION. SPECIAL PROBLEMS OF THE INTERNATIONAL ECONOMIC COOPERATION IN THE AVIATION FIELD IN PARTICULAR RESPECT TO DEVELOPING NATIONS [STAND UND BESONDERE PROBLEME DER DEUTSCHEN ZIVILLUFTFAHRT. BESONDERE PROBLEME DER INTERNATIONALEN WIRTSCHAFTLICHEN ZUSAMMENARBEIT AUF DEM GEBIET DER LUFTFAHRT INSBESONDERE MITENTWICKLUNGSLAENDERN]

Hans-Christoph Seebohm and Gerhard Fritz 25 Jun. 1964 50 p In GERMAN

(Rept.-11) CFSTI: HC $2.00/MF $0.50

Organization and competitive ability of the German civil aviation industry are discussed in connection with international economic aspects for developing countries. Current international aviation agreements that include Germany are outlined and methods to extend their effectiveness and scope are projected. Transl. by G.G.

N66-34065*# Documentation, Inc., College Park, Md. NASA Scientific and Technical Information Facility.

GUIDE TO THE PROCESSING, STORAGE, AND RETRIEVAL OF BIBLIOGRAPHIC INFORMATION AT THE NASA SCIENTIFIC AND TECHNICAL INFORMATION FACILITY

W. T. Brandhorst and Philip F. Eckert Jun. 1966 154 p refs (Contract NASw-1315)

(NASA-CR-62033) CFSTI: HC $3.25/MF $1.00 CSCL 05B

Document processing techniques utilized by the NASA Scientific and Technical Information Facility are described in general terms. Computerized information storage and retrieval techniques are described in detail. The current basic file organization is that of a linear file. File size, after the first 4 years of Facility operation (1962–65), is nearly a quarter of a million items, and is growing at a rate of approximately 75,000 a year. Storage is on magnetic tapes and the system makes use of an IBM 1410 computer system for data manipulation and retrieval. Retrieval techniques are varied and utilize Boolean Logic (with negation), weighting of terms (featuring a grouping technique permitting the simulation of Boolean Logic), searching of "roots" (leading strings of characters), and the ability to intermix descriptive cataloging elements with subject index terms. The report is designed primarily as an instruction manual for analysts, librarians, and information specialists whose organizations are within NASA's decentralized tape user program. The historical perspective which is provided on the development of the program makes the report suggestive for organizations planning to implement mechanized documentation systems. Several appendixes permit the report to function also as a reference tool in the general area of NACA–NASA publications. Author

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NASA is depositing its technical documents and bibliographic tools in eleven Federal Regional Technical Report Centers. Each center, located in one of the organizations listed below, is prepared to furnish the general public such services as personal reference, inter-library loans, photocopy service, and assistance in obtaining retention copies of NASA documents.

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In addition, NASA regularly sends its publications to the Enoch Pratt Free Library located in Baltimore, Maryland.

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—NATIONAL AERONAUTICS AND SPACE ACT OF 1958

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